NEEDS ASSESSMENT OF THE EPIDEMIOLOGICAL INFORMATION SYSTEM IN THE MEXICAN INSTITUTE OF SOCIAL SECURITY

by

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The IMSS is updating their information systems. The epidemiological information systems are one of the most important information sources to define health policies.

We analyzed epidemiologists' needs of epidemiological information systems; described utilization of these systems, and explored epidemiologists' attitudes towards utilization of computer applications.

During summer 2002 we applied a survey. We included epidemiologists who were active workers and excluded participants that answered less than 80% of the questionnaire.

From 467 participants 34.7% were females, age 46.56(±5.92), 99.4% physicians, 48% work in primary care units. Epidemiologists have been performing their current position 7.86 years (±6.02). Almost 67% have computer, 22.3% e-mail and 35.3% Internet access.

Those with computers access spent less time filling forms and more time doing data processing. Epidemiologists with information technology access developed stronger networks and communications channels than those who didn't.

Just 13% of the epidemiologists have published at least one article, those with computers published 1.83 more times than those who didn't, 34% are doing research activities, those with

computers did 1.65 more research activities than those without, and participants with Internet access did 1.74 more research than those who didn't.

Epidemiologists' opinion about the accuracy of epidemiological information systems wasn't influenced by computer access (X^2= 60.86, p<.001), e-mail (X^2=1.94, p=.20) and Internet (X^2=1.94, p=.16).

Epidemiologists who have computers opined 23% more that notification channels are slow than those who didn't (X^2=1.20, p=.27) and, those who have Internet access agreed 38% more (X^2=2.65, p=.10) and who have e-mail opined 68% more (X^2=5.36, p=.02).

Epidemiologists who have computers agreed 30% more that notification forms are accurate than those who didn't (X^2=1.31, p=.25) and those with Internet access agreed 1.54 more times (X^2=3.83, p=.05).

There weren't differences among information technology access and epidemiologists' agreement towards the convenience of computer applications, as well as consequences of computer applications. There weren't differences among epidemiologists' age, gender, time in job position, working time in IMSS and job position and opinions about desirability of computer applications.

Epidemiologists' opinions were that epidemiological information systems are working well but have to be improved some areas. There was acceptance toward IHC in public health.

Acknowledgments

Since I left my country to reach one of the most important achievements in my life, many people have been supporting me in different ways to all of them I would like to dedicate this work.

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1. INTRODUCTION

Interactive health communication (IHC) applications, through their information, emotional support, decision support and behavior change services, have the potential to dramatically improve the public's quality of life and reduce the total burden of illness and injury. Their emergence has been fueled by the growth and increasing sophistication of the Internet, which allows geographic barriers to fall and offers people an opportunity to learn from widely diverse resources. [1]

Expert systems, video, and access to large databases are state of the art in stand-alone systems and are becoming practical on web-based systems accessible at home, in clinics, and in public places such as libraries or kiosks. This extends opportunities for patients and families to become much more informed about their diseases and to potentially become valuable partners in care. [2,3]. Combining computers, communication networks, online medical information, and electronic patient data can improve health care decisions, prevent dangerous oversights, increase access to care, and reduce unnecessary cost. [4,5]

New information technologies may provide a way to ensure and improve quality in health care while at the same time preserving and even enhancing the autonomy of health care providers. The answer lies in the power of the Internet. By increasing the personalized health care information available to patients in real time, the availability of online information systems may increase the knowledge of some consumers to such an extent that they will become quite discerning and sophisticated purchasers of health care services. [6, 7]

IHC applications have great potential to improve health and well-being. Compared to more traditional media, interactive media may have several advantages for health communications efforts. These include: improved access to individualized health information; broader choices for users; potential improved anonymity of users; greater access to health information and support on demand; greater ability to promote interaction and social support among users, and between consumers and health professionals; and enhanced ability to provide widespread dissemination and immediate updating of content or functions.

In most developing countries, given the poor infrastructure and inadequate access to computing both in homes and public institutions, the likelihood of patient/doctor and/or patient/Internet-site consultation is slim. What is instead viable, and could have a major impact on health services provided in developing countries, is consultation among health professionals through Internet-site consultation. [8]

Until now relatively few IHC applications have been developed in public health. However, developed countries already had some successful experiences, but this kind of technology has not been exported in mass to developing countries. The main barriers for those countries to get access to IHC applications are the lack of telecommunication infrastructure and the costs. Nevertheless the consent among health professionals of developing countries is that they are willing to take advantage of the IHC to improve health care in their communities.

In Mexico, since some years ago some IHC applications have been developed. But until now few of them have been applied nation-wide. Some of them have indirectly benefited the public health arena, but there still remains much to do. Recently governmental decision makers have pointed to the necessity of a nation-wide health information system network (like for example, e-Mexico project).

The current processes of health reform in Mexico, and the structural and organizational changes of health institutions should be linked with a substantial improvement of the medical information system, because in some way that promotes integral medical care with efficiency and quality to the population.

The introduction of a national health network in the Mexican Institute of Social security (IMSS) allows the institution to have automated medical information networks that would support transmission and analyses of medical and epidemiological data, interactive and relational databases, online applications, and interactive communication; that would favor standardization of some procedures, as well as cost and time savings.

To implement these changes it is necessary to incorporate new methods, techniques and instruments that allow knowledge about the health needs of the IMSS affiliated population, as well as to identify priorities of care, research and health education.

Currently, most of the epidemiologists in Mexico are in key position within the health care system, because often they are the bridge between clinical and administrative areas, and consequently they have widest knowledge of health problems in their medical care units. They are part of the target population to ask what their needs are and what their opinions are about how to improve the epidemiological information systems.

The current process of structural changes in the IMSS, the disposition of policy-makers to update technology infrastructure, as well as the current challenge of public health and human resources well disposed to find better options to improve their performance, makes prevailing to assess about what are the needs of the epidemiological information system in Mexico.

During the summer of 2002 we surveyed epidemiologists from the IMSS to assess two main issues, epidemiological information systems' needs and desirability of interactive health communication applications.

We found that epidemiologists' opinions were that the current epidemiological information systems are working properly nevertheless they have to be modified in contents, structure and accessibility in order to improve their efficiency and utility. In the other hand, it was almost unanimous acceptance toward IHC in public health fields. Epidemiologists are willing to work in automated networks environments and they are well disposed to contribute with ideas that support computer applications in public health. Then, this research assessed these issues and provides some answers.

2. BACKGROUND AND RATIONALE

2.1. Interactive Health Communication

Interactive health communication plays an increasingly important role in providing health information to the public. The rapid development of new technologies, concurrent with the expansion of the Internet, provides widely available opportunities to obtain interactive information, education, and support that are tailored to individual needs and preferences. A plethora of new vehicles and media disseminate interactive health communication applications. These encompass the Internet accessed by computers, stand-alone or locally networked computers, kiosks, cable, and satellite services. [(9)]

Interactive health communication (IHC) can be defined as the interaction of an individual - consumer, patient, caregiver, or professional- with or through an electronic device or communication technology to access or transmit health information, or to receive or provide guidance and support on a health-related issue [(10)]. The term "IHC applications" is used to refer to the software programs or module that interface with users rather than the hardware and infrastructure technologies that run these applications. In this case, IHC applications do not include electronic applications that exclusively focus on administrative, financial, or clinical data, such as electronic medical records, dedicated telemedicine applications, expert clinical decision-support systems for physicians, or applications focused solely on health professional education. [(1)]

IHC applications are available on a wide variety of health topics and can focus on a single health condition or target a group of conditions. These programs range from applications designed to convey limited health information to complex clinical decision-support tools and modules that are designed to influence health behaviors. The degree of user interactivity can be limited and short-term (e.g., selecting an option to obtain specific health information) or involve a series of complicated interactions over a prolonged period of time (e.g., monitoring and managing a chronic health condition or shared decision making applications). Applications can be developed using one medium (text) or multimedia techniques (combinations of text, sound, still graphics and video); in addition, the costs of systems-development range from minimal cost to millions of dollars depending on complexity. There are also a plethora of vehicles and media disseminating IHC applications. These include stand-alone or locally networked computers, the Internet (accessed through computers, kiosk, TV, or other electronic devices), dial-in services, cable, satellite and other wireless modes, and CD-ROM and DVD and other information storage and delivery technologies. [1]

Of course, seeking health-related information is one thing, whereas enabling or producing positive change in quality of life, health outcomes, or community health may be something entirely different. The purposes of IHC technologies include: (1) relaying information, either specific to an individual or of general public health import; (2) enabling informed decision making on the part of patients or general health consumers; (3) promoting healthy behaviors through the application of theory-based behavioral health interventions; (4) promoting peer information exchange and emotional support where individuals with specific health concerns connect with others to share information and improve understanding; (5) promoting self-care through the use of one or more simple or expert system-based information sources; and (6) managing and optimizing the demand for health services through either one-way or two-way communication about health problems, ranging from minor acute concerns to complicated chronic disease management. [1, 5, 11]

It has been proposed that computer-mediated communication constitutes a form of communication that is intermediate between mass and interpersonal communication in its attributes. Others suggest that computer- mediated communication allows for “desmasification”- the delivery of specialized content to different individuals. It is noteworthy that these communication technologies may also confuse the distinction between communication media (through which informational content passes) and informal tools. Many applications allow experts not only to provide information and directions, as in traditional mass media information campaigns, but also simultaneously to enable individuals to direct and control their own use, and to tailor the interaction and information to their particular needs. [9]

The scope of health-related applications on the Internet is as broad as medicine itself. Most medical schools and many hospitals have Web sites which, in part, serve as marketing devices, but also serve important community service needs, such as helping patients find special programs and providing public health information. Some sites are intended specifically for physician education. Some serve as repositories of specialized knowledge, maintained by researches in those areas, and are intended to be accessed by patients and physicians. Other sites are home to discussion groups for patients to discuss health-related problems with other patients or with health care providers. Increasingly, the Internet is being used by health care providers to communicate with each other in the course of routine patient care and has been used as a framework for distributing medical records. In other cases, Web sites advertise health-related products and services. [12]

Knowledge has been portrayed as a good that is available to the global public and as something that is not diminished after being used by an individual, and once provided it has been seen as difficult to restrict to a single individual or a group. Advances in information and communication technologies make the global distribution of this good seem effortless. The technology, specifically the World Wide Web, enables information to be made available to multiple users the instant it is produced. Anyone can use it, whether an ordinary woman living in a village or a high-ranking policymaker. [13]

Health information itself has been transformed on the Internet. It is now a commercial product available on over 17,000 web sites. Health is the single largest type of news sought by Internet users, by 40% in the US alone. The majority of online American Medical Association journal users are not doctors, but the public. Physicians say that 60% of their patients now come to them with Internet printouts, demanding further information or treatment. Not surprisingly, medical advertising will be worth $265 million within two years, as direct-to-consumer drug marketing takes up half of all online health advertisements. In a word, "health" has gained "portal" status-it is first to grab users' attention when they go online, from whence they can be led to commercial offerings, an avenue that sellers are willing to pay for. Health has become the (spider's) web to catch the unwary information seeker. [14]

More importantly users are not passive recipients. They can choose the type of information they wish to access. They can even produce or package the information themselves.

However, it is rare for a woman in a developing country to have access to the Internet. In Africa, which has a population of 700 million, fewer than one million people had access to the Internet in 1998, and of this number 80% were in South Africa. Among the other 20% the ratio of people who have access to the internet to those who do not is 1 to 5000 in the United Nations

Development Programme: "there are more [internet] hosts in New York than in continental Africa; more hosts in Finland than in Latin America and the Caribbean; and notwithstanding the remarkable progress in the application of [information and communication technologies] in India, many of its villages still lack a working phone". That the digital divide is more dramatic than any other inequities in health or income is depressing because information and communication technologies have been hailed as one of the potential solutions to these inequities. The financial barriers to Internet access are considerable, even just counting the cost of usage fees and telephone time, which range from $100 to $1800 annually and average about $704 in Africa. (13)

The International Telecommunication Union affirms that, on a global scale, Internet growth has been little short of phenomenal. The network has increased from 213 host computers and several thousand users in August 1981 to more than 56 million Internet hosts by July 1999 supporting an estimated 190 million Internet users. Perhaps even more impressive is the number of countries connected to the global network. From just over twenty in 1990, there were more than 200 nations connected by July 1999. But there are great disparities between high and low-income regions of Internet hosts. For example there are almost as many hosts in France as in all of Latin America and the Caribbean, there are more hosts in three highly developed countries of the Asia-Pacific region (Australia, Japan and New Zealand) than all the other countries in the region combined and there are more hosts in New York than in all of Africa. (8)

The Americas Telecommunication Indicators 2000 from the International Telecommunication Union report emphasizes that although the situation has improved, Latin America still faces the hard fact that not much more than one-third of the region's households have a telephone.

In contrast, the combination of private ownership and increasing competition has placed mobile markets in Latin America amongst the fastest growing in the world. The number of mobile cellular subscribers in Latin America soared to over 39 million in 1999, up from just 100,000 subscribers in 1990, and 3.5 million in 1995. One possible explanation for this phenomenon is that in some cases a wireless phone is more expensive than a mobile phone.

In Mexico, the exponential growth of mobile telephony can be at least partly attributed to the introduction of pre-paid services in 1993. By 1998, the country had the largest number of cellular pre-paid subscribers in the region, some 60 percent of all mobile users. By the end of 1999, almost 85 percent of Telmex cellular subscribers were on the pre-paid plan “Amigo”.

Latin America is getting feverish about the Internet. The number of Internet host computers grew faster in Latin America than in any other region of the world in 1999 and reached a significant milestone, surpassing one million. Internet users in Latin America climbed almost 14-fold between 1995 and 1999, from just half a million to over 9 million. This Internet expansion is even more striking considering the general economic growth in the region was flat in 1999. [(15)]

The Pan-American Health Organization (PAHO) [(16)] in a workshop in October 2001 showed that in the Americas the communication infrastructure in particular by fixed telephone lines per 100 persons in 1998 was distributed as follow: USA 65%, Canada 62%, Chile 21%, Argentina 20%, Colombia 18%, Brazil 17%, Mexico 12% and Venezuela 11%. With respect to personal computers per 100 persons the distribution was: USA 44%, Canada 33%, Uruguay 8%, Chile and Mexico 4%, Argentina, Venezuela and Costa Rica 3%, Brazil 2.5% and Colombia 2%.

In April 2001 the total number of Internet users in the world was 427, 213, 610; of these were 47.95% in North America, 4.12% in South America, 0.38% in Central America, 23.63% in Europe, 18.58% in Asia, 4.56% in Oceania and 0.78% in Africa. [16]

PAHO pointed out that in 2000 the total population connected to the Internet in Latin America & the Caribbean was 17,135,000. Brazil contributed 9.84%, Mexico 2.5%, Argentina 0.90%, Chile 0.625%, Colombia 0.60%, Peru and Venezuela 0.4%, Uruguay .30%, Costa Rica 0.15% and the others 0.52%.

It is relevant to say that in terms of Internet connectivity per 100 persons in the Americas, the first places correspond to USA and Canada. In contrast, with less than 10.0 % and more than 1.0% connectivity per 100 persons are Uruguay, Chile, Costa Rica, Mexico, Argentina, Brazil, Venezuela, Peru and Colombia (in this order)

The total number of hosts in April 2001 in South and Central America & the Caribbean was 1,825,760, 43.58% corresponded to Brazil, 26.43% to Mexico, 14.69% to Argentina, 5.45% to Chile, 3.18% to Colombia, 2.95% to Uruguay, 2.23% to Venezuela 2.23% and 1.49% to the others.

In 2000 the percent of the population using Internet services in Uruguay was almost 8.0%, Brazil almost 6%, Chile 4.0%, Mexico 3.5%, Argentina 2.5%, Venezuela almost 2.0% and Colombia 1.5%.

From 16,566 hospitals registered in Latin America 31.57% (5,230) reported using computers and 62.17% not. From those who have computerized hospital information systems, Argentina, Brazil, Colombia and Mexico represent 80.94% of the total. Also it is important to mention that in almost all of the Caribbean countries more than 50% of their hospitals have computerized information system. [16]

In 1997, the information technology industry was the single largest industry in the United States in terms of sales, accounting for 33% of the growth in GNP in 1996. An estimated 41.5 million U.S. adults were active users of the Internet in 1997, and more than 43% of Internet users have used it to research health information, including health information and social support as vehicles for recovering from illness. [17]

A survey from the National Telecommunications and Information Administration of the United States shows in 1997 the following nation-wide penetration rates—93.8% for telephones, 36% for personal computers (PCs); 26.3% for modems, and 18.6% for on-line access. [18]

The US Census says that in August 2000, 54 million households, or 51 percent, had one or more computers. Forty-four million households, or 42 percent, had at least one member who used the Internet at home in 2000. In 2000, more than 4 in 5 households with a computer had at least one member using the Internet at home.

E-mail is the most common use of the Internet at home. Home Internet users, both adults and children, sent or received e-mail in 2000 more often than they participated in any other online activity.

In 2000, the Internet has become a major venue for the dissemination of news. Among adults, nearly 1 in 5 used the Internet at home to check on news, weather, or sports. Nearly 1 in 4 adults used the Internet for other sorts of information searches, such as information about businesses, health practices, or government services. The Internet also affects interpersonal communication. About 1 in 3 adults used e-mail from home. More than 1 in 5 children used home e-mail. Finally, the Internet acts as a venue for work and school to enter the home. [19]

According to the 2000 national census, in Mexico from 21,513,235 households there were 7,791,935 telephone lines (36.22%) and 2,011,425 personal computers (9.35%). The distribution of telephones and computers per household in towns with less than 2,500 inhabitants was 1.47% and 0.02%; in cities with more than one million inhabitants it was 7.81% and 1.97%, respectively [20]

In November 2001 the Research Department of the Mexican Newspaper “Reforma” [21] conducted a telephone survey in Mexico City. They randomly selected 807 people; after applying the selection criteria they interviewed 596 users of the Internet. Forty-seven percent were calls to households and fifty-three percent to work places.

They found that 53 percent of the interviewed people in work places use the Internet at least one time per day; in comparison 35% of the households use the Internet occasionally.

The thirty-three percent of the household users use the Internet to e-mail; 14 percent to be in chat rooms; to do research or homework, 14 percent; to surf the net, 12 percent; and nine percent for entertainment purposes. Fifty-three percent of the workers use the Internet to e-mail, 12% to consult or participate in chat rooms, 8% to surf the net and, 6% to search for information.

Household users said that when they are looking for information they usually prefer topics related to education and science (76%), technology and computers (69%), news (65%), and entertainment (50%). In contrast 72% of the work users prefer websites related to technology and computers, 69% news, 68% science and education, and 57% business. [21]

In another report, the same newspaper pointed out that currently there are 4.2 million Internet users in the country. But there is no available information about how many physicians have access to the Internet and how many of them have developed computers skills and use them to support their professional activity. [22]

2.2. Current Status of Health in Mexico

Mexico currently has a predominantly young population. However, the decreases of the fertility rate since the beginning of the 70's as well as the decrease of the mortality rate have led to the gradual ageing of the population.

According to the XII General Census of Population and Housing, in February 2000 the Mexican population reached 97.4 million. The annual demographic growth rate in the period of 1990-2000 was 1.9, showing a continued decrease trend.

Currently, the population younger than 15 years old represents 34% of the total population, while the population in the productive ages -15 to 65 years- represents 60.6%, and the aged population, 5% of the total habitants of the country. [20]

In the next 20 to 30 years the ageing of the population will be faster than it is now. This fact implies an increase in the demand of medical care, especially with those services related to chronic and degenerative diseases care.

According to the Ministry of Health, in 1999 the general mortality rate was 4.5 per 1000 inhabitants. Some of the most frequent causes by 100,000 inhabitants were heart diseases (70.6), cancer (54.7), diabetes mellitus (46.5), injuries (36.4), liver diseases (27.6), and stroke (26.3). [(23)]

In the Mexican Institute of Social Security (IMSS) the general mortality rate in 2000 was 3.08 per 1000 affiliates. The most frequent causes per 100,000 IMSS' users were cardiovascular diseases (71.12); endocrine, nutritional and metabolic diseases (52.12); and cancer (51.67). (24)

In terms of morbidity rates per 100,000 IMSS' users during 2000: hypertension was 564, diabetes mellitus 190, diarrheic diseases 8,049, parasitical diseases 1,582, and respiratory diseases were 35,956. [(25)]

Chronic-degenerative disease has come to be more important than infectious diseases as a consequence of the improvement of the living conditions in the population, better access to health services and specific effects of public health policies.

Nowadays the main causes of mortality and morbidity are cardiovascular diseases, cancer, and accidents, but infectious diseases, respiratory diseases, gastrointestinal disease, nutritional disorders and maternal deaths persist as common causes of death in highly deprived areas of the country. Mexico has had a delayed epidemiological transition; some of the reasons are the economical and social inequalities of the population as well as the inefficient health system that has promoted unfairness in access to health services to the poorest people.

Data from the census show that of 97.5 million Mexicans, only 39,120,682 have some kind of social security service. From those, 31,523,279 people are affiliated with the Mexican Institute of Social Security. In 1999 there were 117 physicians, 118 nurses and 79 hospitals-beds per 1000 habitants. [20]

2.3. The Mexican Health System

The Mexican health system basically provides medical care and public health services, and the Ministry of Health coordinates them.

The national health system is a mixed system, where public and private sectors converge to attend health population necessities, with a regulation by the State, which is ruled by the Ministry of Health. For health policy-making decisions all these institutions conform to the National Health Counseling. [23], Figure 1

The private sector consists of hospitals, clinics and medical personnel that offer their services to the market, and the people that usually have access to these services are those that have purchasing power or health insurance.

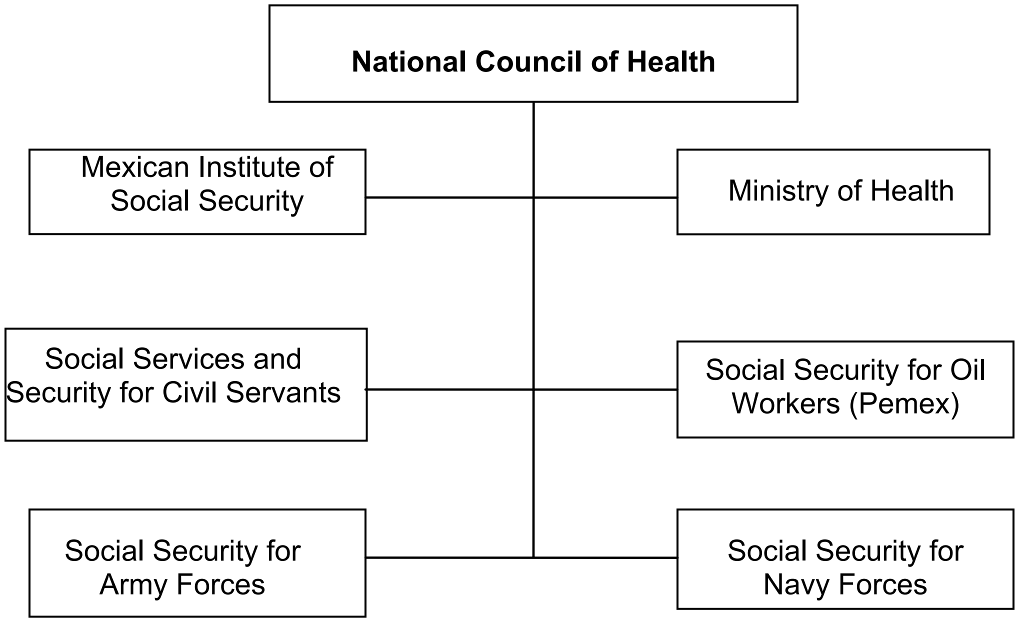

Figure 1. Organization of the Mexican National Health System

The health public sector is divided into two big groups, one of which involves the services oriented to the poorest people without social security benefits. These care services are provided basically by the Ministry of Health and by non-profit organizations.

The second group is the social security system that also provides health care services for those people and their families with social benefits. It is comprised of the Institute of Social Services and Security for Civil Servants (ISSSTE), Social Security for Oil Workers (Pemex), Social Security for Army Forces, Social Security for Navy Forces, and the Mexican Institute of Social Security (IMSS). Figure 1

2.4. The Mexican Institute of Social Security

The IMSS is considered to be a health and social security institution, financed by taxation and contributions that deliver health, economic and social services. It is recognized as the main and best public provider of health services in Mexico.

IMSS is organized into 37 "delegations". Each delegation is semiautonomous with Regional and Central divisional dependence. The headquarters structure is copied at the delegation level, which means that each central division has its equivalent in the delegation in order to follow the same programs, strategies and activities at the national level. Figure 2

The medical care is provided by a regionalized structure and by levels of care. The first level is provided in the Family Primary Care Units (UMF). The first level solves approximately 85% of the health problems. The second level of care is provided in General Hospitals (HGZ) and Regional Hospitals (HR) with four basic specialties (pediatrics, gynecology and obstetrics, internal medicine, and general surgery). In this level, patients that require complex procedures of diagnosis and treatment are attended. The specialized hospitals comprise the National Medical Centers (CMN); they provide the third level of care. There are physicians in each specialty and sub-specialty that provide medical care to patients with those diseases that need high medical technology and highly qualified personnel. Here also is where the main research and teaching activities take place. Figure 3

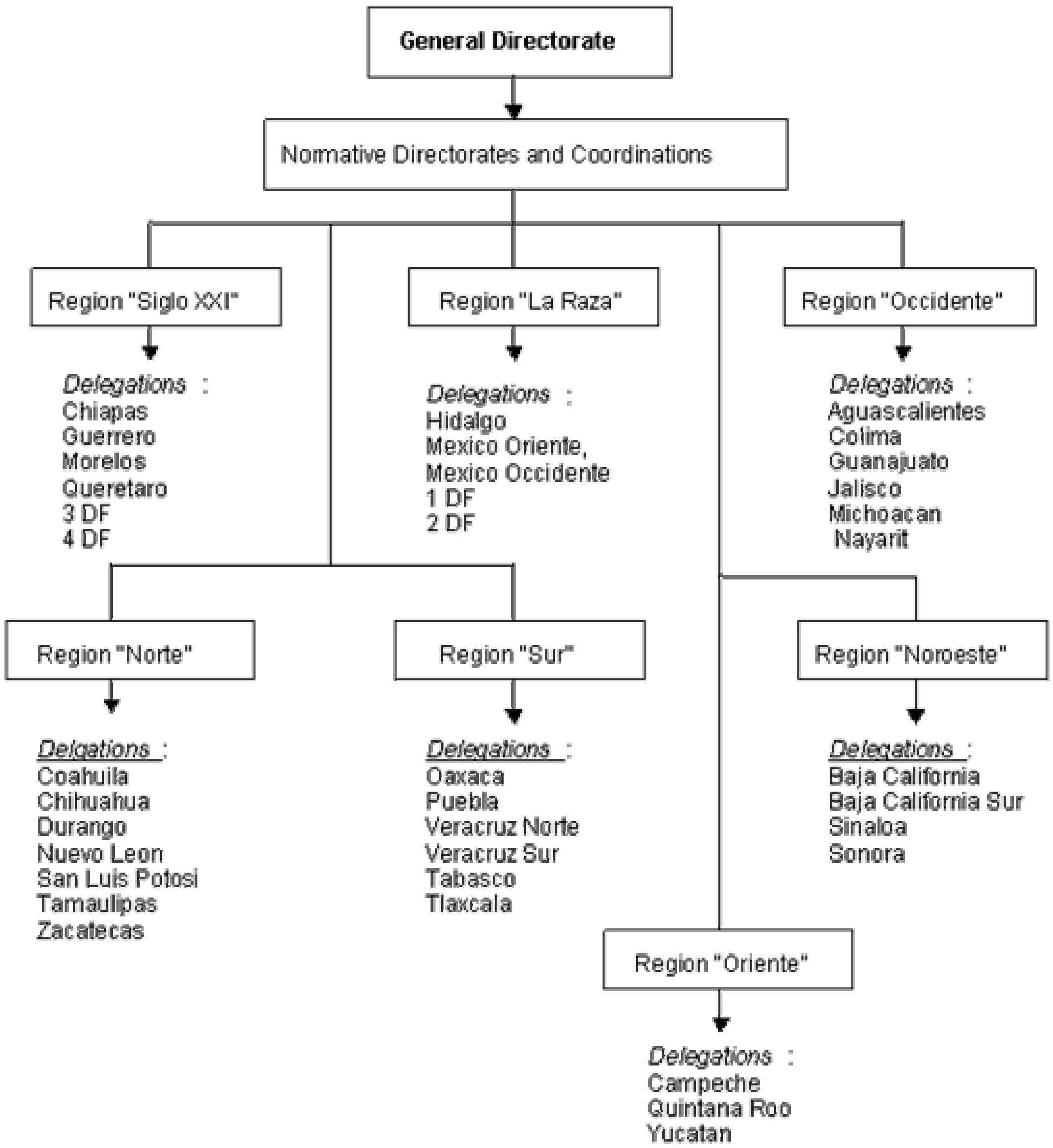

Figure 2. General Organization of the Mexican Institute of Social Security

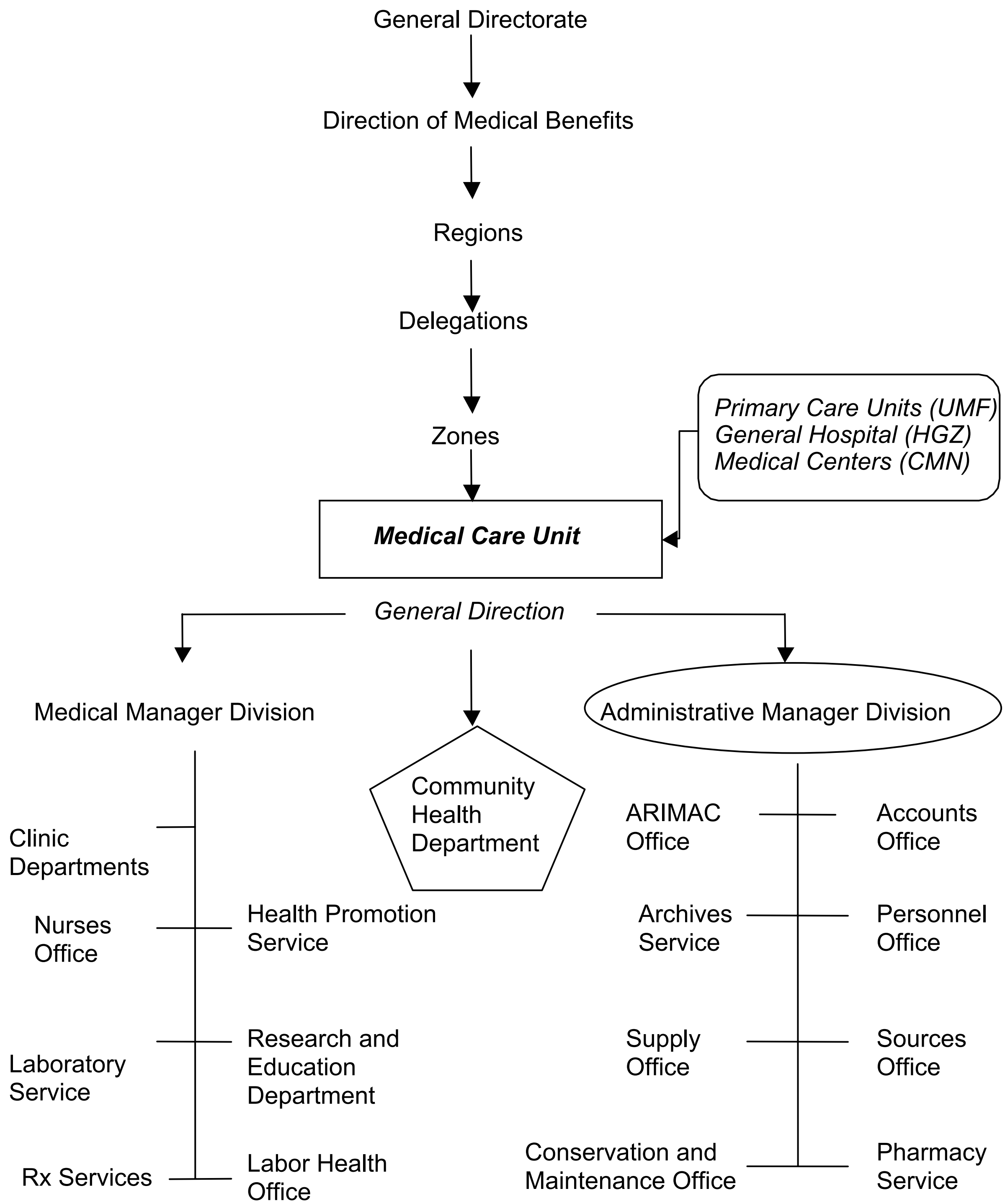

Figure 3. General Structure of the Medical Care Units

The head of IMSS is the General Directorate who is selected by the President of Mexico. The next level (central level) is divided into ten normative directorates and co-ordinations. One of them is the Directorate of Medical Care Benefits, which is organized into seven general co-ordinations: Planning and Medical Infrastructure, Medical Care, Occupational Health, Reproductive, Maternal and Child Health, Medical Education, Medical Research and Community Health. Each coordination establishes its own plans, strategies, programs and evaluations but follows the general policy of the Medical Benefits Director. (26) Figure 4

The Coordination of Community Health is focused on public health activities. This Coordination is divided into four divisions: Prevention and Control of Diseases; Health Promotion; Epidemiology; and Information, Development and Evaluation. Each division is in charge of planning, developing, and evaluating public health programs; for example, the division of the prevention and control of diseases evaluates immunizations and screening programs, and the division of epidemiology is in charge of the epidemiological surveillance system. Figure 5

The community health services in each medical care unit have as a main goal the identification of risk factors in the population, health promotion, prevention, control and surveillance of those diseases with epidemiological impact to reach the welfare and health equilibrium of the population under their charge.

In the medical care units (MCU), there are specialized medical personnel in public health that implement health programs in the prevention and control of disease, screening, epidemiological surveillance and health promotion without difference between affiliated people of their MCU or others MCU, child care centers, IMSS workers or even the general population. Figure 3

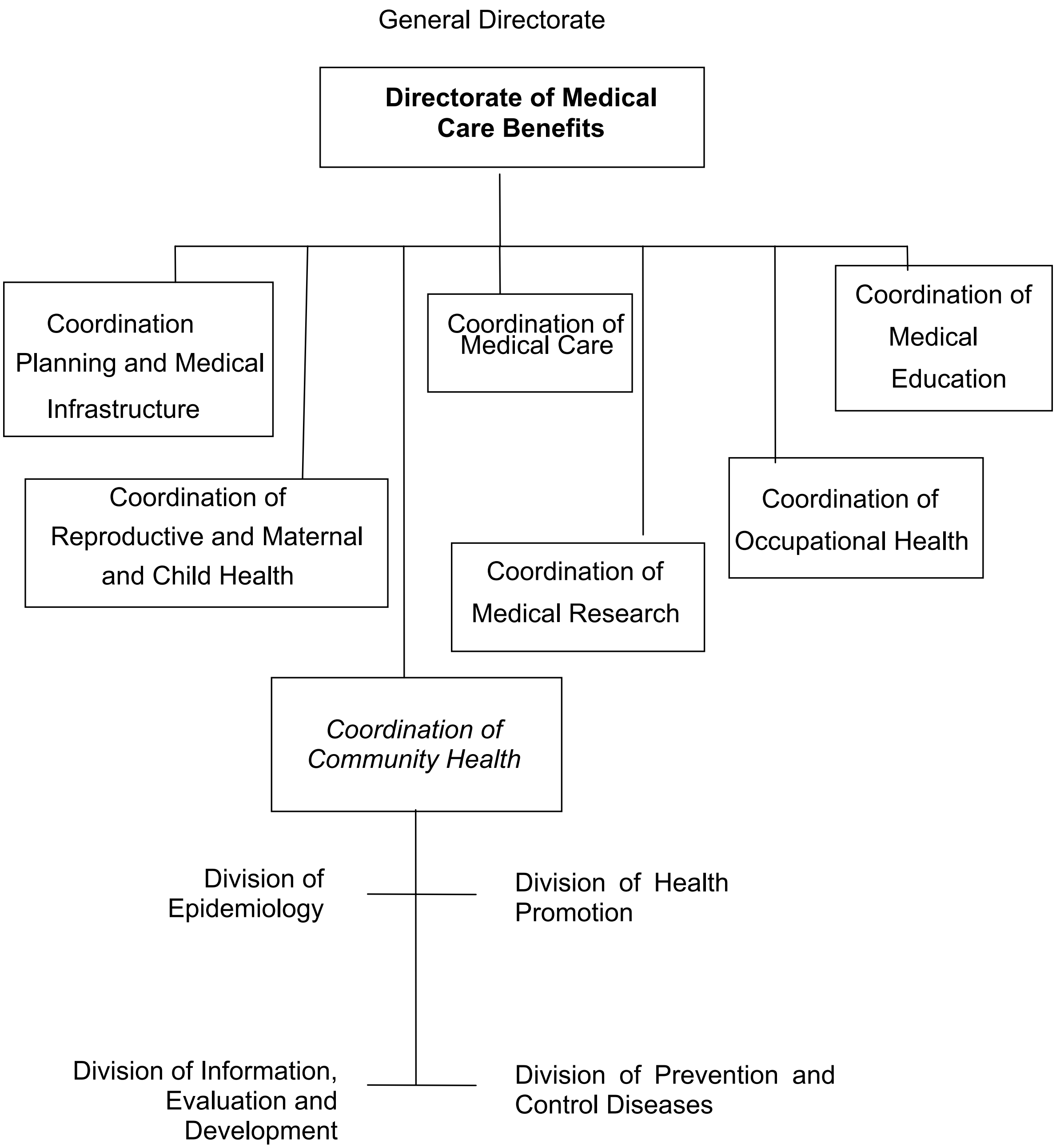

Figure 4. Organization of the Directorate of Medical Care Benefits

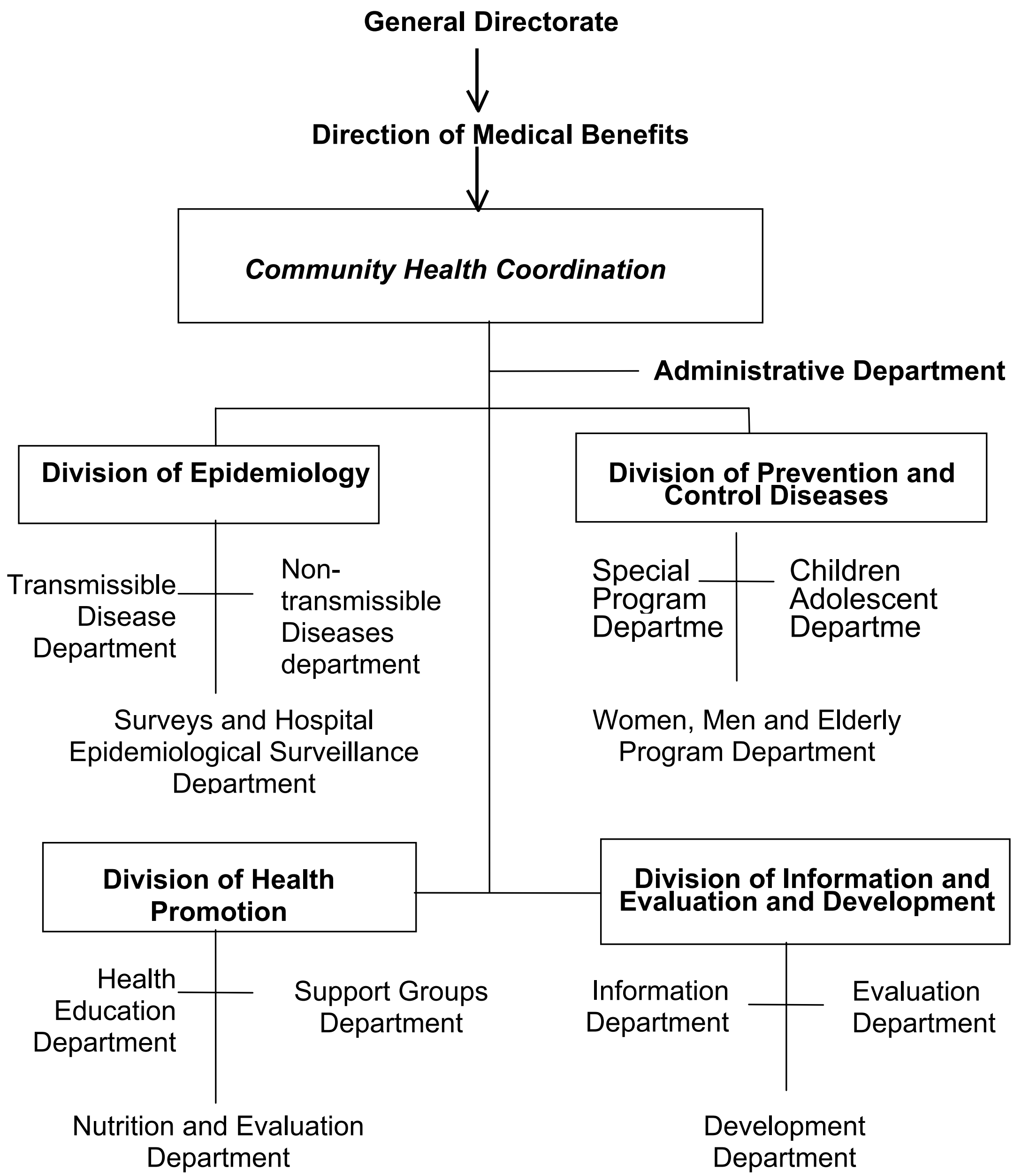

Figure 5. Structure of the Community Health Coordination

These activities are the same at all medical care levels, but depending on their area of influence and affiliated population each care level is focused on specific activities.

In primary care units the public health service is in charge of immunization programs (children and adults), screenings programs (breast cancer, cervical cancer, diabetes mellitus and hypertension), epidemiological surveillance (AIDS, cholera, flabby paralysis, tuberculosis, dengue, diarrhea, viral hepatitis, cervical cancer and rubella and measles), the prevention and control of diseases (tuberculosis, rheumatic fever, malaria, sexually transmitted diseases, oral hydration) and health promotion activities (health education, preventive dentist, etc.) with target group populations such as elderly, children and workers. In this medical care level, the personnel in charge of these activities are one epidemiologist, one or two general practitioners (GP), one or two public health nurses (PHN), one or two general nurses and two to ten technical nurses.

The main activities of the second care level are focused on epidemiological surveillance, health damage analysis (morbidity and mortality), surveillance and control of intra-hospital infections, clinical epidemiology and the application of specific immunizations. In this level there is one epidemiologist, one GP, one PHN and one general nurse or technical nurse in each hospital.

In the third level, the maternity hospitals perform epidemiological surveillance, surveillance and control of intra-hospital infections, and the application of poliomyelitis and tuberculosis vaccines to newborns. The medical care centers do activities related to epidemiological surveillance, surveillance and control of intra-hospital infections, health damage analysis (morbidity and mortality) and clinical epidemiology. Usually in this level there is one epidemiologist, one PHN and one technical nurse.

In all medical care levels the people that coordinate all these activities is a physician with a specialty or master degrees in epidemiology or public health. The epidemiologist is in key position in the medical care unit's structure because it is he or she who establishes the communication channels and links with other clinical and administrative areas in the MCU, as well as with other MCU and external institutions (i.e. Ministry of Health). The epidemiologist supervises, analyses, plans, evaluates and coordinates public health activities. Another important function of epidemiologists is to advise, teach and train other members of the MCU (including the chairman and his staff), patients and the general population. Finally, one relevant activity of epidemiologists is related to research activities as researcher or providing advice. Figure 6

In general the community health services in all care levels perform three main activities: preventive care, epidemiological surveillance and health promotion.

Preventive care activities are focused on immunizations, vaccination censes, screening tests for diabetes mellitus, hypertension, breast cancer, and cervical cancer; prevention and control of tuberculosis, rabies, malaria, rheumatic fever, sexually transmitted diseases, diarrheic and parasite diseases. Nurses under an epidemiologist's supervision do these activities; each activity has its own notification form and communication channel to delivery. For example, figure 7 shows the information process of the immunization census program.

The epidemiological surveillance covers transmissible and non-transmissible diseases. It is a routine activity that, depending on whether or not the new cases are under active or passive surveillance, uses the weekly report or the immediate notification. Diseases under active surveillance are tuberculosis, cervix cancer, HIV/AIDS, cholera, dengue, measles and poliomyelitis. The last four diseases compulsorily require immediate notification. Figure 8

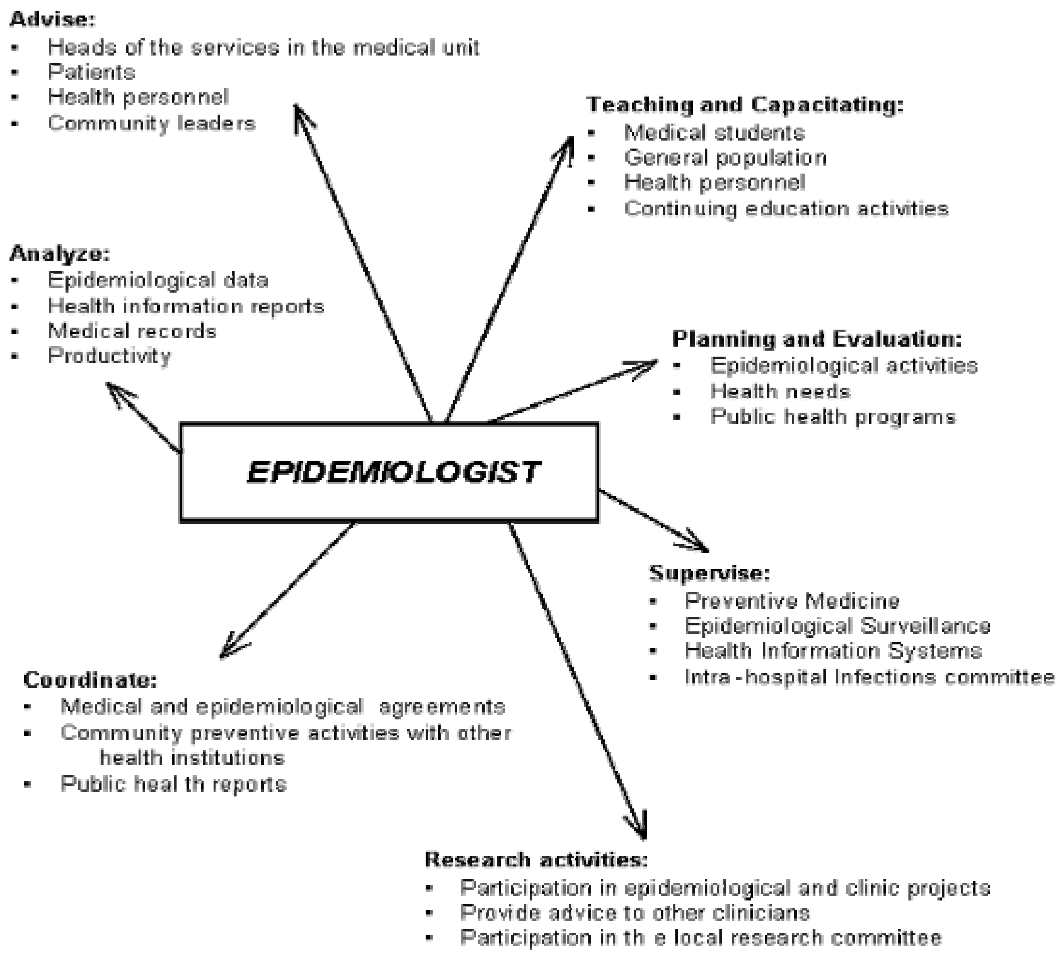

Figure 6. Epidemiologist's Functions in the Medical Care Units

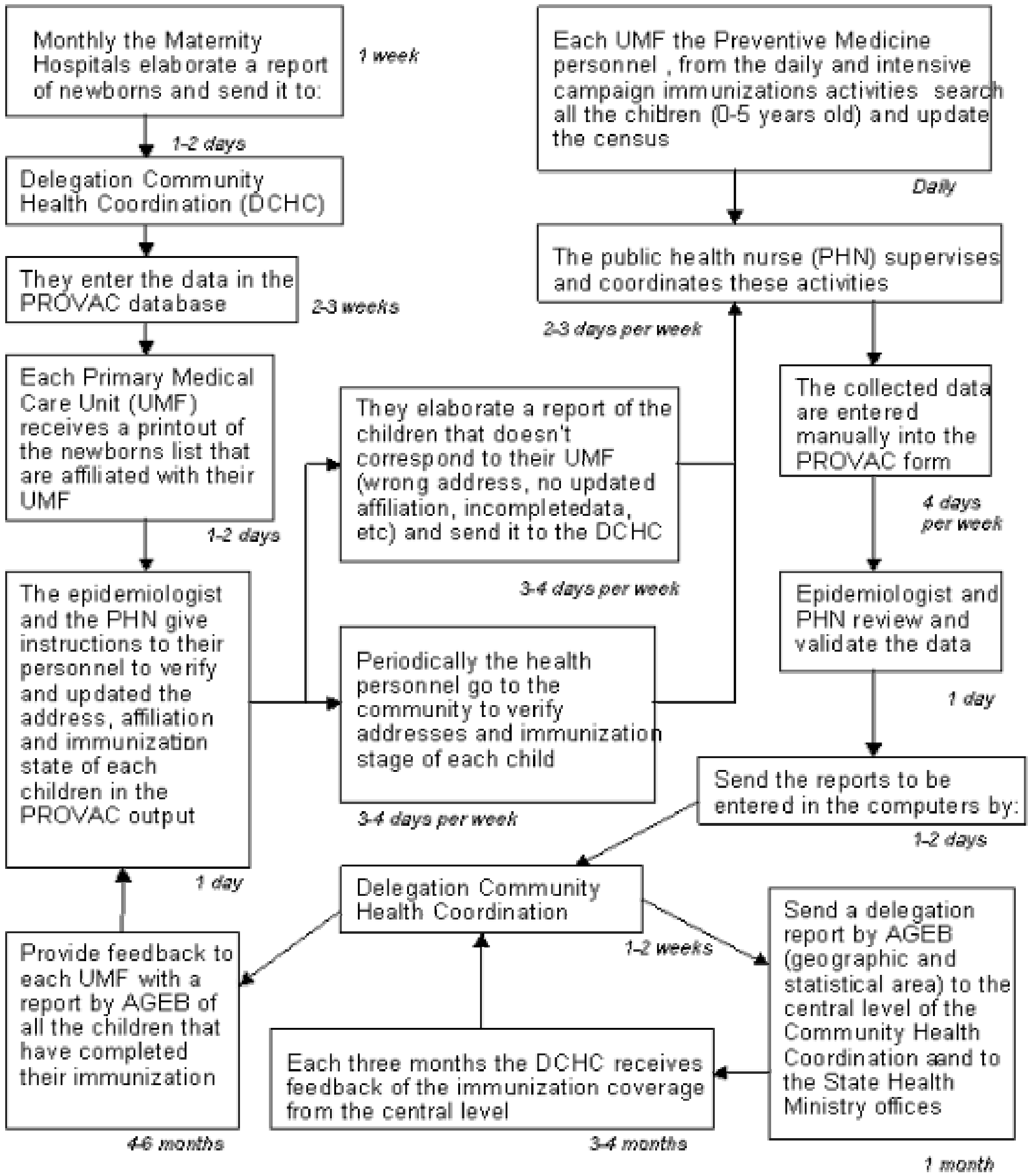

Figure 7. Organization of the National Immunizations Program (PROVAC)

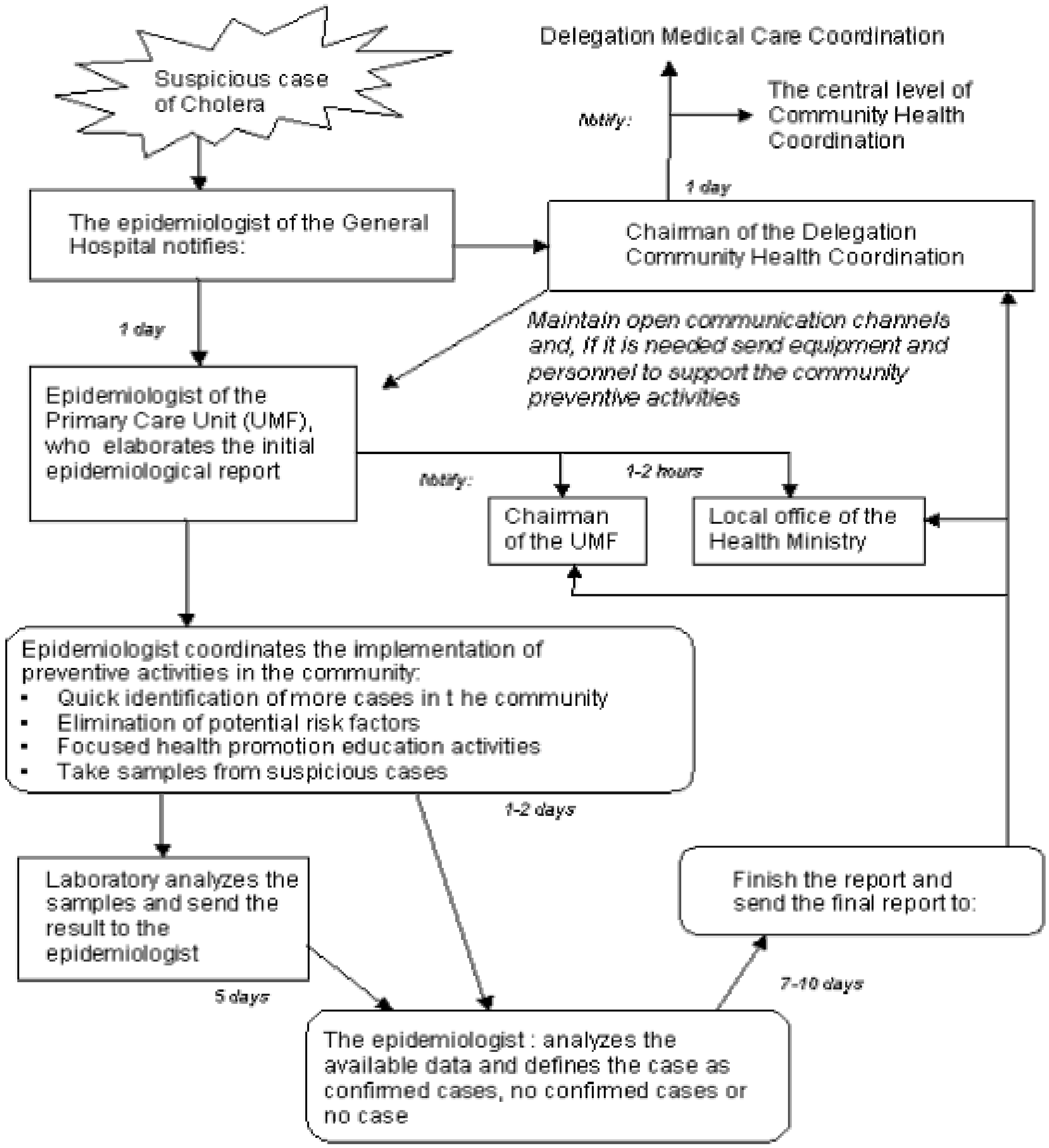

Figure 8. Organization of the Epidemiological Surveillance Program of Cholera

Outbreaks are notified with an immediate report by phone or fax, followed by a formal notification of the case using the established channel of communications.

Diseases under passive monitoring are notified by weekly report of transmissible and non-transmissible diseases (Figure 9). The process starts when physicians fill out a daily activities registry form. Then the area of integration of information (ARIMAC) enters and codifies the data, and epidemiologists supervise and validate the report. The process ends when the central level receives the information by each delegation.

Finally the health promotion activities are focused on preventive dentistry, health education and social-health activities with target populations like elderly, children and workers. These activities are mainly performed in schools, factories and neighborhoods previous solicitudes of the affiliate population. All these activities are monthly registered in one report that ARIMAC personnel enter the data and the epidemiologist validates the output before sending to the delegation.

2.5. The Epidemiological Information System

For all the activities described above, the epidemiologists have specific forms to fill out and epidemiological reports to submit to upper levels. In general there are weekly and monthly reports that are sent to the delegation level. Currently each epidemiologist in the MCU periodically fill out 22 reports; from those, six are weekly, eight monthly, one each four months, two each six months and five with variable frequency. This information is usually concentrated in the delegation, where it is sent to the central level to be analyzed. Additionally the epidemiologists fill out the epidemiological report of those cases that have specific notification forms, such as AIDS, cholera, poliomyelitis or measles.

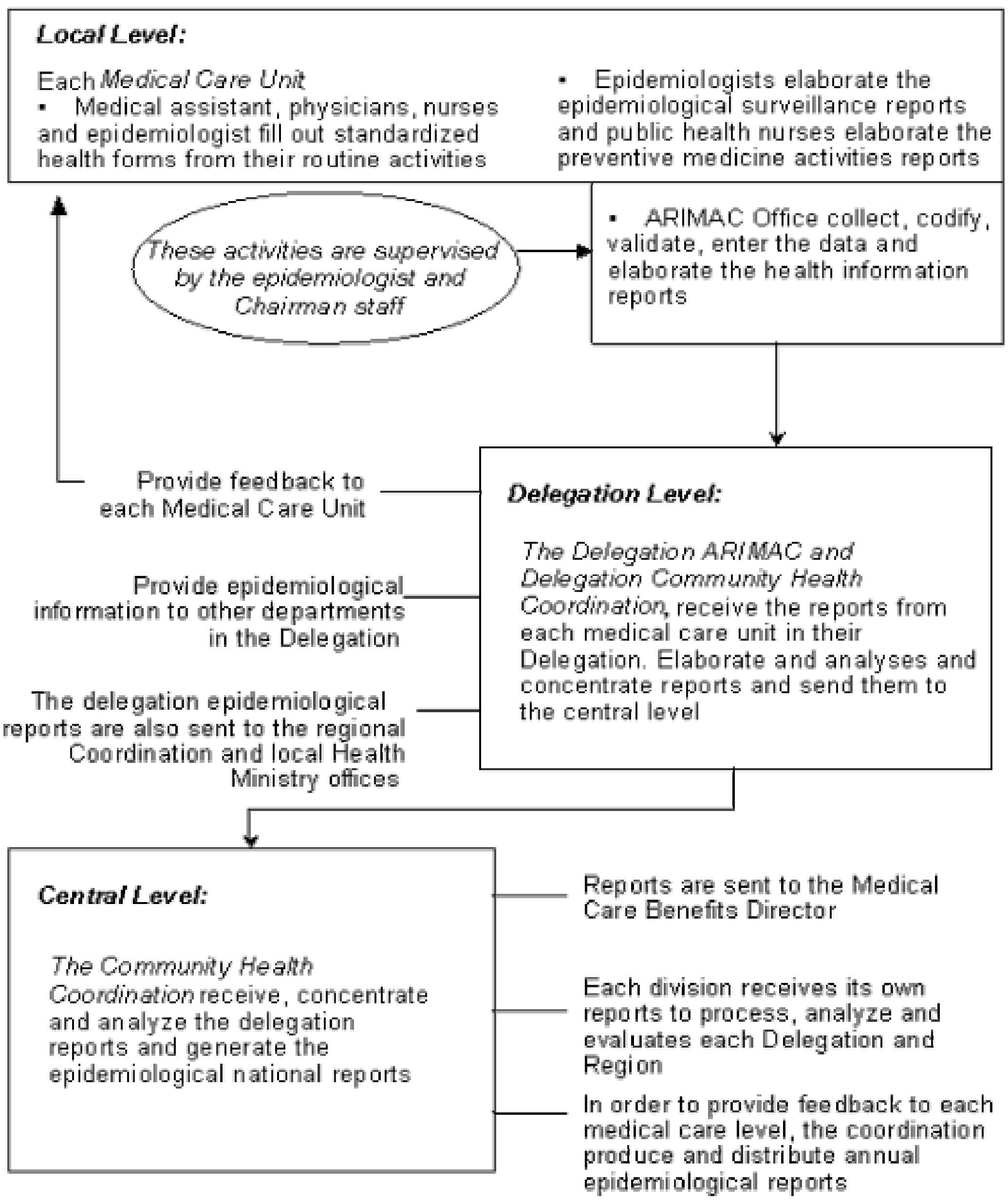

Figure 9. General Organization of the Epidemiological Information System

The main sources of information of the Coordination of Community Health are each MCU. These sources are comprised of the reports of community health services (vaccines, screening programs and epidemiological surveillance monitoring) by the physicians that take care of the patients (medical records from outpatient consultations and hospitalizations) and by the ARIMAC office (records of mortality, morbidity and productivity).

This information is concentrated and analyzed by the epidemiologist of each MCU in co-participation with the ARIMAC personnel and under the final approval of the chairman. Later, the information is sent to the Delegation Coordination of Community Health. This coordination collects the reports from all the MCU's under its influence and subsequently sends concentrated reports to the central level. In this point of the process a first feedback is given by the delegation coordination to each MCU when it is needed. Figure 9

In the central level of the Coordination of Community Health, these reports are distributed in the corresponding division to be analyzed and evaluated. In this level health policies in public health are modified if it is required on the basis of the information received from the 37 delegations. The Community Health Coordination at the end of each year prepares memos and annual reports such as bulletins to give feedback to lowers levels. Figure 9

The generated information in each MCU is the fundamental element for making decisions. The planning of the health intervention activities, the evaluation of the prevention and control programs, and the trend analysis of the diseases are based in the epidemiological information provided by each MCU.

Currently, there are more than eight health information systems nation-wide used in the IMSS; the most relevant to the public health area are the medical activities information System (SIMO), the medical preventive activities information system (SUI-29), the epidemiological surveillance system (SIVEIMSS), the mortality registry (SISMOR), and the planning and budget aims and sources system (SYSMET). [25]

The Medical Activities Information System (SIMO)

The IMSS set up the SIMO in the 80's. It contains complete prescribing and diagnostic information from a large number of general practices in the medical care units and is the largest source of continuous data on illness and prescribing habits in the IMSS. Every workday all the physicians fill out by hand a form with standardized recording of clinical information. Trained personnel of the ARIMAC office who codify the information enter these forms into the computing systems. The available data from the database include all drug prescriptions, a record of every consultation and of every diagnosis. The data collected is audited regularly and the participating general practices are subjected to a number of quality checks. In this case all the heads departments are involved in the supervision process.

The general practitioners keep all referral letters, hospital discharge summaries and other clinically relevant letters in a manual file. In addition to the electronic health record, patients (or their parents) can be contacted via mail or via general practitioners, and copies of letters relating to referrals and hospital care can be obtained. The data are held anonymously in the central SIMO database, with patient identifiers removed.

The medical preventive activities information system (SUI-29)

The SUI-29 was stared in the 1990’s; it contains the entire medical-preventive activities related to immunizations, screening programs, sanitation activities, vectors control, preventive dentistry and health promotion activities. Figure 10

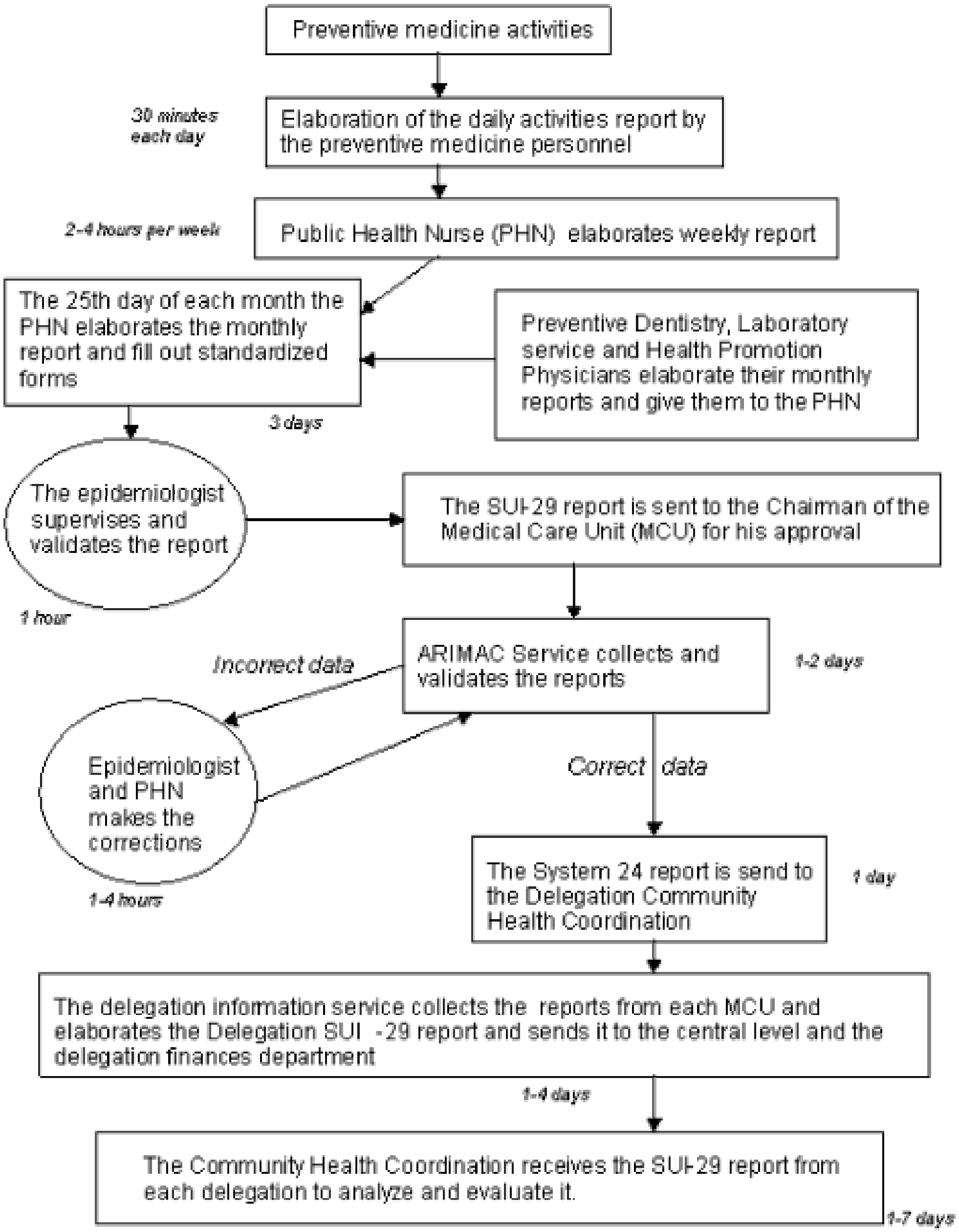

Figure 10. Organization of the System SUI-29

The community health service personnel, under the epidemiologist's supervision and the final approval of the MCU chairman, fill out this report each month. ARIMAC transmits the report to the upper level of finances and community health co-ordinations.

The epidemiological surveillance system (SIVEIMSS),

In 1995 an agreement was made among all health institutions that comprise the National Health System to create the national epidemiological information surveillance system (SUIVE). In 1996, based on these antecedents IMSS created the SIVEIMSS, which contains the same information as SUIVE, plus other diseases of specific interest for institutional planning and medical decision support. This system is linked with the SIMO. This information is collected by ARIMAC personnel, supervised by the epidemiologist and validate by the chairman of the medical care unit and the final report is sent every week to upper levels.

The mortality registry (SISMOR),

Between 1997 and 1998 SISMOR was updated according to the 10th International Disease Classification (IDC-10) and the database structure was expanded and improved to allow a better mortality analysis. Data come from death certificates, and ARIMAC personnel enter them into the system. The epidemiologist supervises and validates the final report and the head of ARIMAC send the final report to the delegation's offices.

Planning and budget system of aims and resources (SYSMET)

This system is comprised of three basic modules: resources, aims and budgets. This system is the tool to elaborate annual budgets of the medical preventive services in each medical care unit.

Before 1995 this system was highly centralized and basically performed by hand. In 1996 the aims module was decentralized to each medical care unit. Later in 1998 the resources module was opened and in 2000 the cost module was added. [25]

The public health nurse and the epidemiologist in each medical care unit, fill out the data of each module one time per year. The chairman, the administrative services and the delegations community health coordination supervise and give them the final approval. (IMSS bulletin)

Diagnosis of health in the local, delegation and national levels is based on the information systems described above. The planning and budget of aims and resources of the community health services take these information systems as their reference. This wide epidemiological information system is also needed to know the epidemiological panorama of the affiliated population, their health status, the health actions and the main causes of morbidity and mortality.

2.6. Experiences of Interactive Health Communication in Mexico

During the last decade some isolated efforts have been made to develop IHC applications in Mexican health care systems, like ISSSTE telemedicine program, where the main hospital is providing online consultations between physicians and patients to remote hospitals to support them in difficult cases.

Also the Secretariat of Health, after the creation of the SUIVE program, developed software to register the diseases under epidemiological surveillance; currently the information of each state is sent through e-mail or FTP to the central level. Currently others systems are under development like mortality and intra-hospital disease registries.

The Health Ministry in 1994 launched its web page. Currently it is one of the best sources of statistical information of mortality and morbidity in Mexico. [(23)]

The IMSS during last years has been developing some experiences in health networks but until now none of them has been well coordinated or implemented nationwide. Most of these applications are in the clinical field and in administrative areas. In spite of the limited results of these projects the overall balance has been positive.

For example, medical education coordination developed some kind of intranet between the main IMSS's library and each hospital library. But also, some isolated efforts have been made by physicians to get Internet in their hospitals using their own resources.

The IMSS has a project called "Primary Care Century XXI" in which fewer than six primary care units in Mexico City are participating. These care units are completely automated with internal networks that provide connectivity between all the departments (Laboratory, Rx, Preventive Care, and Registry) and the physicians. This project is using electronic patient's records and decision support systems. Recently the hospital of oncology has been joined to this project and it is under evaluation to expanding to other hospitals.

Administrative and finance areas in the IMSS have updated their hardware and are developing specific software to meet their needs. Nowadays the IMSS users registry, the storage and supplies registry and the personnel registry are partially connected nation-wide.

Recently SIMO, SIVEIMSS and SISMOR systems were partially automated and standardized with dedicated software and the data are transmitted from each delegation to the central level via e-mail and/or FTP.

Currently, the IMSS is working on the development of automation of their entire information system. They want to develop a nationwide network between the central level and all the delegations and medical care units. The project is oriented basically to improve and make more efficient their performance and finances as well as to provide accurate knowledge of their users.

The Community Health Coordination recently has been joined to this project; the goals are to update their hardware and software infrastructure, to modernize the epidemiological information system, to improve efficiency and quality control, to provide online communication between epidemiologists, as well as continuous education and opportunities to develop epidemiological research. A multidisciplinary team of epidemiologists, decision makers, information science engineers and computer science engineers are working on this project.

This project is in the initial stages. It will require a huge investment not only of financial support, time, infrastructure, design, and manpower but also, a deep research into what are the necessities of the potential users in terms of health information and how this project will impact the health in the affiliated population.

3. SIGNIFICANCE

3.1. Importance of Interactive Health Communication

Technological development that has been reached by telecommunications can improve processing and dissemination of information in public health. Nowadays a huge part of public health and epidemiology actions depend on data sending and reception. It is here where telecommunications could allow us to improve health information systems in order to have a more efficient and cost-effective response to population health needs.

Technologies involved in IHC include everything from simple telephone services to synthetic virtual environments. Typically developed successively over time, each new technology adds value to previous ones while offering new capabilities. The use of telephone services for prevention-related communication can be as simple as personal reminder calls for immunizations or mammograms. Computer-generated telephone calls have also been shown to be effective for in-person interviews for health status measurement and certain forms of behavior therapy.

Kiosks and other forms of non-networked computers, often with substantial multimedia capability, also show promise in health promotion and disease prevention. Areas such as skin cancer prevention, diabetes education, nutrition, and headache management in occupational settings have been evaluated. The use of networked computers, using local area networks or the Internet, also demonstrates promise for health education and prevention. Areas investigated to date include office-based access to designated websites for patient education, the sue of web and wireless technologies to improve connectivity and communication among public health workers contending with tuberculosis in the inner city, and the feasibility of using the web for diabetes self-management. Although not yet widely applied to health promotion and disease prevention purposes, advanced virtual reality environments have been used for educating health professionals about HIV/AIDS and have been advocated as a learning medium for wellness education. (5)

3.2. Advantages and applications of IHC

One way to improve and make the information system more efficient is the introduction of informational technology, such as networks, telecommunications, software, relational databases, and the Internet, with the purpose of automating and standardizing all the information system procedures. In that way that information will be available at all levels, with friendly interface, a standardized and flexible content, and with possibilities for managing the data.

Some reports in the medical literature show that interactive health communication using Internet technologies significantly affects the range and flexibility of the intervention options available in preventive medicine. Such technologies will increasingly influence consulting-room services of physicians and other practitioners, are opening new options for proactive mass-reach strategies for large population groups, and will affect significantly preventive services delivered through health maintenance and other health organizations. These new developments present a plethora of new opportunities and challenges. They will extend the range and precision of initiatives by practitioners, researches, government agencies, non-profit groups, and private sector bodies in delivering disease prevention and health promotion services. (27)

The most evident benefits of IHC are:

Improved access to individualized health information

Broader choices for users

Potential improved anonymity of users

Greater access to health information and support on demand

Greater ability to promote interaction and social support among users and between consumers and health professionals

Enhanced ability to provide widespread dissemination and immediate updating of content or functions

In addition, emerging technologies such as the Internet allow users to also become developers and active participants in the information exchange process. They can glean what they wish from various sources and create and disseminate new information. Thus, these users become health communicators. (1)

A very illustrative example of how IHC applications can be useful to the public health comes from the World Health Organization (WHO) (28). WHO has developed an Internet application linking the global WHO network of influenza centers (FluNet; http://oms.b3e.jussieu.fr/flunet) to improve management and enhance standardization of reporting. This early-alert system for the global monitoring of influenza provides international and national authorities, the public, and the media with full access to real-time epidemiological and virological information.

Data on influenza activity and viral laboratory results were entered into the FluNet database during 1997 from 22 selected pilot national influenza centers. The output included summarized data on the extent of epidemiological activity and virological results by geographical location during different periods. These outputs were represented as graphs, maps, animation tables, and texts that can be downloaded and retrieved in the form of a spreadsheet. [28]

Also, Alemi and colleagues [29] in their study show that computerized reminders sent to parents led to an increase in participation rate at the clinic and an increase in on-time immunization for their infants.

The participation rate for appointments for the experimental group was 82%, as compared to a 69% overall participation rate for the clinic providers. The on-time immunization rate for experimental subjects was 67.8%, whereas the comparison group had an on-time immunization rate of 43.4%.

With access to IHC applications, consumers gain greater control of influences over their health, and health professionals may become more effective and efficient providers of care, health information and support. Gains in community and individual health status and reduced health care cost may result as access to health information and support increases, and patients and others become more knowledgeable and empowered health consumers.

A very good example of a successful experience in the use of nationwide IHC applications is the case of the Netherlands [30]. From the late 1970's and early 80's general practice computer and information systems were introduced and further developed. In 1989 about 25% of Dutch general practitioners (GP) had a practice computer, of whom 10% used it for medical purposes; in 1998 these figures were 90% and 60%, respectively. Today, computerization in general practice is even more developed than in hospital care.

In Holland in general practice, computerization has made important contributions mainly in two fields of application. First, the practice computer was early recognized as a powerful tool for administrative purposes. Second, guided by the experience in developing administrative applications, general practice computers and information systems were used to support clinical care.

For both scientific research and practice- or policy-supporting research automatization has proven to be highly innovative. In the Netherlands research is carried out in both single practice and local and national practice networks. Some major advantages over the “paper era” are:

Legibility

Considerable time saving

Better standardization and quality control of entered data

Feasibility of research into infrequent problems

The possibility of conducing longitudinal studies in a natural relationship with continuity care.

It has become possible to obtain useful descriptive data on health problems, morbidity, health care processes, procedures and outcomes, and performance of professionals, as well as identifying, monitoring and actively inviting or visiting high-risk subpopulations. [30]

If a national health network were introduced in the IMSS, the users in the medical care units would benefit most, because they are the ones who generate the information and they are in touch with the population. If they can use more information then they will be able to analyze and correct on time the procedures and results of their health interventions in the population.

Some of the benefits of introducing IHC technology could be decreasing the man-hours to collect data to the system, receiving immediate feedback to make decisions, homogenizing the way of data entering, carrying and standardizing basic analysis of epidemiological data that improves the decision-making process in each level of care and normative co-ordinations, increasing the coverage of public health programs, developing a national network that allows faster, efficient and opportune data transmission and, promoting a rational use of the epidemiological information to the planning and administration of the health system in the IMSS.

Additionally the system could favor clinical-epidemiological research activities such as the development of interactive online databases or multi-center studies. In the medical education field, the advantages could be highly cost effective and efficient with the introduction of online continuous long distant education programs, teleconferences, internet medical journal access, and online public health references (manuals, norms, procedures, etc.) that could allow each epidemiologist in his own work place to perform his own continuous education activities according to his needs and preferences.

3.3. Considerations about the implementation of IHC applications

There are four stakeholder groups that must participate if meaningful evolution and quality improvement of IHC is to occur consumers (including patients, families and caregivers), health care professionals and purchasers, IHC developers, and policy-makers. Consumers are the intended users of most IHC applications. Health care professionals often mediate the use of these applications with consumers, and are often involved in the development of IHC applications. Potential health care purchases, including health plans and employers, determine whether IHC applications are implemented for their plan members or employees. Developers of IHC applications have ultimate control of the quality assurance aspects of these interventions, and are clearly influenced by the needs of the purchasers. Policy-makers can influence the climate in which the other stakeholders make decisions about the development, use, or purchase of IHC applications. [1, 11]

In the case of the epidemiological information system within IMSS and IHC applications, the most important stakeholders are the epidemiologist (and their personnel) of each MCU, the developers (the Community Health Coordination and the Informatics Coordination personnel) and the policy-makers at the central level.

According to Jimison [11], from the health care provider or purchaser perspective, it is important that evaluations of IHC applications address outcomes related to quality-of-care and cost effectiveness. One outcome to consider may be the potential for market growth with the use of IHC applications. Use of such systems may be likely to engender client satisfaction and loyalty, as well as encourage new enrollments. Cost saving may be expected from systems that facilitate disease management, self-care, and self-triage. However, as with many medical interventions, it is important to measure whether the desired effect of a system is actually obtained in routine use. The measured outcomes should be relevant to a medical health care organization's decision on whether or not to purchase and use such a system. Product evaluations of IHC applications must target the outcomes from a meaningful and coherent perspective.

Targeted outcomes related to cost and quality of care from the purchaser's perspective include: (1) cost-all expenditures potentially influenced by the use of the system and (2) quality-including provider satisfaction, patient satisfaction, knowledge gains, health behaviors, health outcomes, access, process control, more appropriate utilization of health care services, and concordance between utilization and expressed preferences (decision quality). [1, 11]

The benefits of evaluation for developers can be: increased sales, higher profit margins, increased market share, improved effectiveness, utility, and reliability of the product; evaluations may also decrease potential liability for harm caused by a product and may minimize or prevent regulation of these products. (1, 31)

Several externalities may positively or negatively influence the practice of IHC evaluation, including legal, regulatory, social, and economic processes. Some of these processes result from the legislative efforts of federal and state governments acting on behalf of the public interest. Others stem from the purchasing decisions of federal, state, and local governments and of private institutions. Still others stem from informal “policies” of private health care enterprises such as resources they use, and whom they refer when their patients need health information. All of these factors also influence the marketplace for IHC that others typically follow.

Also the decision-makers of all types need to understand more about IHC technologies and applications. These individuals need a process that enables assessment of the efficacy, effectiveness, and impact of IHC applications. Of potentially greater importance, however, will be the mechanisms by which policy-makers can understand the “value-added” by HIC to the overall mix of public and private investment in the promotion and protection of individual and community health, in disease prevention, and in medical care and rehabilitation. Knowing how IHC applications relate to, enhance, and/or potentially detract from other determinants of individual and community health may enable choices to be made which promote the wisest investment in IHC development and use. (1)

Research and development (R&D) in information and communications technologies now represents 37% of total R&D by U.S. companies. Nonetheless, health and medical care are prominent among those business and social sectors considered to be most underdeveloped from an information technology perspective. Investment in information technologies is seen by many as essential to the creation of manageable and cost-accountable medical care and public health systems. [32]

In contrast, in Mexico R&D in IHC technologies is practically nonexistent. There are some applications already working in some health institutions like the IMSS, but until now all of them are isolated and uncoordinated efforts that need more development.

Several areas of health information policy are already undergoing extensive review in the context of expanded use of telecommunications and computer technologies. These include health data and information standards, network security issues, and legislative actions at the federal and state levels addressing issues such as medical information privacy, confidentiality, and security. [32]

Before the introduction of new technology, it is necessary not only to redesign the information system and to evaluate the requested infrastructure, it is also important to evaluate the needs of the potential users, their attitudes to the utilization of this technology in their daily activities to improve the organizational environment, as well as to recognize the capacity level of each user. Otherwise independently of what innovative would be the new tool the probabilities of failure would be greatest if in practice this innovation doesn't resolve at least the user’s minimum needs. [33]

3.4. Barriers to Developing of IHC Applications

Although the potential benefits of IHC are impressive, there is the risk of harm. Use of inappropriate or poor-quality applications, however, can result in the following potential negative outcomes:

Inappropriate treatment or delay in care

Damage to the patient-provider relationship

Violations of privacy and confidentiality

Wasted resources and delayed information

Unintended errors

Widening the technology and health gap (1)

Two of the major impediments to successful use of interactive health communication approaches are cost and access.

The initial cost involved in developing interactive health communication may be prohibitive in many circumstances. Organizations that do not possess significant information technology infrastructure may consider strategies based on these technologies to be less cost-effective than those based on more traditional communications channels.

Access to Web-based programs is not universal. Socially disadvantaged groups may not have access to new information technologies.

What are the barriers to increased Internet usage? The precise ranking of different obstacles differs, according to the level of economic and social development, but users around the world are unanimous in finding the price of Internet access to be a major constraint. Internet access prices for end users can be broken down into three components: Hardware/software, Internet access provision and telephone service charges. In relative terms, the costs to get connected are much higher in developing countries. [8]

A shortage of infrastructure, notably of telephone lines, is a further big obstacle to increasing Internet access in developing countries.

Barriers to integrating preventive services into clinical health care are well documented and include lack of standardized counseling protocols. The need for providers to address multiple health behaviors also serves as a barrier to preventive services. These barriers limit the provision of recommended behavior-change services of physicians, nurses, and other providers who are not trained or reimbursed for these important tasks. [33]

But on the other hand, a number of key pathways of information technology evolution are creating new opportunities for delivering professional education in preventive medicine and other health domains, as well as for delivering automated, self-instructional health behavior-change programs through the Internet. Such as: Developments in the use of HyperText MarkUp language (HTML), the use of portable document files (PDF), the use of rich text format (RTF), and the development of online forms and surveys [27, 34]

But also to encourage the communication between physicians/patients, patients/patients using mailing list, e-mails, chatting rooms [35, 36], and to improve the quality of entering and sending data through e-mail, FTP, telnet and information retrieval. [36]

Prochaska and colleagues affirm that applying interactive health communication technologies in the clinical setting can eliminate or greatly reduce most of the barriers to the delivery of preventive services. Computerized assessments and interventions enable delivery of comprehensive programs with few demands on staff time. A computer program can screen multiple behaviors, prioritize areas of intervention, and initiate the intervention in a reasonable time frame. Technology-based interventions can be highly individualized to each patient's needs, yet maintain a standardized quality of care. High-quality behavior change programs may be initially expensive to develop and evaluate; however, widespread application is expected to be far more affordable than one-on-one provider counseling. Interactive health communications can be delivered within or initiated from the clinical setting. Computers can be placed in the waiting room for patient use or patients can be prompted to access an interactive program by telephone or Internet before or after a clinical encounter. [33]

The future of health services over the Internet depends heavily on overcoming a number of infrastructural, regulatory and economic barriers. For developed countries issues such as privacy and confidentiality, licensing, malpractice liability, service payments and reimbursements are of high importance. In developing countries, instead, regulatory matters are still far from being a pressing issue in their health agenda. For many of them, having access to the necessary communication infrastructure at a reasonable cost, and taking the initial steps to set up telemedicine pilot projects are of most importance.

Of the 52 millions deaths worldwide during 1996, over 40 million of them were in the developing world. More than 12 million of them were children under the age of five, most of whom died from preventable causes. Many of these deaths could have been avoided and several of the problems faced by health professionals could have been overcome if adequate information had been at hand when needed. But information poverty is one of the most serious obstacles facing health professionals in the developing world.

Furthermore, medical knowledge is evolving rapidly. Historically it has taken up to five years for new knowledge to trickle down, even to those in the general profession who are reasonably well connected to the international flow of information. Beyond the capital city and large urban centers of developing nations the time lag can, of course, be substantially longer. The Internet can significantly shorten this time lag, as well as open up a whole new range of information resources to health professionals in developing nations.

Poor sanitary conditions in many developing countries contribute to the emergence and spread of infectious diseases. WHO's information system on disease events occurring worldwide links all major partners in international response for epidemic control. The use of the Internet for the exchange of outbreak information ensures that crucial information can be rapidly and widely disseminated to public health officers, ministries of health and health professionals in the field. [8]

In many countries, including the US, local and national public health agencies, voluntary and community groups have limited access to the Internet. Where access exists, there are many problems, including

Information excess and unguided searching

Lack of awareness of non-traditional information sites

Over reliance on traditional types of information (for example, epidemiological and fiscal)

Persistent traditional uses of information (for example, staff education, trend analyses, planning, data to support program development, evaluation)

Traditional use of electronic tools (for example, distance learning, videoconferencing, telemedicine, disaster response systems; cost effective health care purchasing and communication within state agencies) [14]

3.5. Problems with Implementing Interactive Health Communications in Health Care

With increasing demands for the introduction of medical information systems as progress towards the information society advances, it is true that diversified problems have been emerging in various communities when introducing or operating medical information systems. Yamamoto and colleagues [37] from the results of their survey summarize these problems as follows:

The first problem is that of the budget for implementation and operation of the medical information system.

The second problem is the attitude of medical personnel concerning the systematization of medical information. The difference in attitudes towards the advanced systems and poor communication among medical personnel are the main factors impeding the organization of cooperation to implement an information network.

Third, the attitudes of medical personnel towards necessary information, the acquisition and management of various items of information and utilization of the information must be studied. It is necessary to review the attitude of 'information first', and study the information control and presentation procedures, which includes careful consideration being paid to the contents and quality of necessary information based on the purpose and needs of medical, hygienic, and welfare activities, and to the protection of privacy.

Fourth, technophobia, namely prejudice against computers and advanced medical instruments, must be addressed. Interactive, multi-functional terminals need more complicated operation. At the same time it will be necessary to provide opportunities for training in the operation of the terminals, and to help conquer the technophobia relating to computers and keyboards.

Fifth, compatibility of data and software among hardware of different specifications is essential. Factors hindering the implementation and operation of community medical information systems may also be found in the lack of cooperation between the municipality and the medical association, and in the lack of manpower needed to promote systematization in the medical association.

The list of several major impediments to successful implementation of clinical computer systems includes: poorly defined user interfaces, systems whose performance does not exceed that of the physician, inability to prove that the system has a beneficial impact on patient care, and systems with an inflexibility that inhibits transferability. [38]

From the health care provider or purchaser perspective, it is important that evaluations of IHC applications address outcomes related to quality-of-care and cost effectiveness. One outcome to consider may be the potential for market growth with the use of IHC applications. Use of such systems may be likely to engender client satisfaction and loyalty, as well as encourage new enrollments. Cost saving may be expected from systems that facilitate disease management, self-care, and self-triage. However, as with many medical interventions, it is important to measure whether the desired effect of a system is actually obtained in routine use. The measured outcomes should be relevant to a medical health care organization’s decision about whether or not to purchase and use such system. Product evaluations of IHC applications must target the outcomes from a meaningful and coherent perspective. [11]

Targeted outcomes related to cost and quality of care from the purchaser's perspective include: (1) cost-all expenditures potentially influenced by the use of the system; and (2) quality-including provider satisfaction, patient satisfaction, knowledge gain, health behaviors, health outcomes, access, process control, more appropriate utilization of health care services, and concordance between utilization and expressed preferences (decision quality). [1, 11]

In general, to judge the design of an IHC application, the basic elements to consider are: Empowerment and self-efficacy, the computer as a health information medium, the influence of individual characteristics on usability, and the issues related to access. [11]

3.6. Needs assessment of Interactive Health Communications

Some textbooks in health systems offer different points of view on the definition of need and needs assessment like those from Bradshaw, as well as Doyal and Gough. [39]

Bradshaw's typology of need says:

Normative need. This is what the expert or professional or administrator defines as need in particular situations.

Felt need. Felt need is equated with want. When assessing the need for a service, people are asked whether they feel they need it

Expressed need. This is felt need turned into action. Expressed need is what economists call the demand for a service.

Comparative need. It is found by studying the characteristics of those already in receipt of a service. If one person with similar characteristics to another is not receiving the same service, then that person is in need.

In contrast Doyal and Gough say that need is a relative and subjective concept. They believe there are objective needs which are common to everyone; they are universal. Their position rests on the idea that, for the ultimate goal of all human beings to be able to participate fully in society, two “basic needs” must be met: the need for physical health, and the need for autonomy. They affirm that there are different levels of need, as well as intermediated needs that are also universal and objective. Basic and intermediated needs can be met in an almost infinite number of ways. (39)

Witkin and Altsechuld (40) affirm that a need is generally considered to be a discrepancy or gap between “what is”, or the present state of affairs in regard to the group and situation of interest, and “what should be”, or a desired state of affairs.

To them needs assessment is a systematic set of procedures undertaken for the purpose of setting priorities and making decisions about programmed or organizational improvement and allocation of resources. The priorities are based on identified needs.

There are levels of need, each of which also represents a target group for the needs assessment:

Level 1 (primary)-service receivers: students, clients, patients, information users, commuters, and potential customers.

Level 2 (secondary)-service providers and policymakers: teachers, parents, social workers, caretakers, health care professionals, plant workers, postal employees, librarians, administrators, supervisor and managers.

Level 3 (tertiary)-resources or solutions: buildings, facilities, equipment, supplies, technology, programs, class size, surgical procedures, information retrieval systems, transportation, salaries and benefits, program delivery systems, time allocations and working conditions. (40)

From the point of view of health information systems and because of the newness of the field agreement does not exist about what is the best way to evaluate IHC applications. Nevertheless currently there are different approaches to performing technology assessment that involve psychology, and epidemiological theories and methods that have been shown to be very efficient.

For example Anderson and Aydin in their book "Evaluating health care information systems" show us some of these approaches. Medical information systems involve computer-stored databases containing patient information to support medical order entry, results reporting, decision support systems, clinical reminders, and other health care applications.

Research and evaluation of information systems may involve any or all the following categories: (1) the external environment of the organization; (2) the internal environment of the organization; (3) the information systems users; (4) the systems development environment and staff; (5) the management and operational environment of the systems; (6) the nature of the system including the information processed; (7) patterns of utilization; (8) organizational impacts; (9) and social impacts. [38]

According to the pluralist position, the introduction of computer systems in health care organizations may be accompanied by changes on several different levels. These include changes for: (1) individuals and their jobs, (2) departments as a whole and how the department's work is performed, (3) the structure and functioning of the entire organization, and (4) the quality of both the service patients receive and the medical care that is delivered.

Understanding the changes that may occur, however, can help analysts predict impacts of individual systems, including both desired and unanticipated effects on the organization in which they are being implemented.

Evaluation research differs from scientific inquiry. Although both use the same logic of inquiry and research procedures, scientific studies focus primarily on meeting specific research standards. Although scientific rigor is important in evaluation studies as well, evaluation research must also recognize the interests of organizational stakeholders and be conducted in a way that is most useful to decision makers. Although evaluation studies may strive to meet criteria for scientific rigor, the primary purpose of evaluation research is to provide information to organization stakeholders and decision makers.

There are three different models of change prevalent in information systems research:

The computer systems as an external force. The simplest approach views the computer systems as an exogenous or external force that brings about change in the behavior of individuals and organizational units. Information systems are developed and implemented to support management goals. Participants who are expected to use the new technology are viewed as passive, resistant, or dysfunctional if they are failing to use the system. Evaluation in this instance usually focuses on technical performance.

System design determined by user needs. In this view, the information system is considered to be endogenous to the organization with organization members having control over the technical aspects of the system and the consequence of its implementation. According to this theory, change occurs in a rational fashion as needs are identified and problems solved.

Complex social interactions as determinants of system use. According to this view, the way technology is ultimately implemented and utilized in a particular organizational setting depends on conflicting objectives, preferences, and work demands. From this point of view, predicting organizational change resulting from information systems requires an understanding of the dynamic social and political processes that occur within organizations as well as the characteristics of the individuals and information system. The prediction of outcomes requires knowledge of the processes that occur during system planning, implementation, and use rather than simply the levels of independent variables hypothesized to predict change. [38]

The panel of IHC in their report considers that inaccurate or inappropriate health information and poorly designed applications may result in harmful outcomes, such as receiving inappropriate treatment or delaying necessary health care-seeking behavior. Most applications are being marketed without formal evaluation of effectiveness or health impact. As with other health care technologies, health care expenditures may rise and resources may be squandered if such technologies are ineffective or harmful.

Evaluation of IHC applications may: Improve quality, utility, and effectiveness, minimize the likelihood of harm, promote innovation, conserve resources, encourage participation of stakeholders in the development and implementation process, promote confidence among end users, and promote positive public image of the industry. [1]

There are many approaches to the evaluation of health interventions like IHC applications. All approaches share one purpose: to systematically obtain information that can be used to improve the design, implementation, adoption, use, redesign, and overall quality of an intervention or program. The design and implementation of an evaluation typically depends on the purpose of evaluation, the stage that the intervention is in, and the type of decision the evaluation is intended to address. Formative evaluation may be used in the early stages of development to assess the nature of the problem and the needs of the target audience(s), with a focus on informing and improving program design and ensuring accuracy of content. During the developmental and implementation phases, process evaluation may be used to monitor the administrative, organizational, or other operational characteristics of the intervention or application. Outcome evaluation may be used to examine an intervention's ability to achieve its intended effect under ideal conditions (i.e., efficacy) or under real-world circumstances (i.e., effectiveness) and its ability to produce benefits in relation to costs (i.e., efficiency or cost-effectiveness). [1, 17]

3.7. Strengths and weakness of the epidemiological information system in the IMSS

Traditionally epidemiological information systems in the IMSS have been one of the most important information sources to decision-makers to define health policies in the Institute. Through time this system has been modified and extended in order to satisfy current demands of health information.

From data obtained in each MCU, the Coordination of Community Health analyzes and provides enough information about morbidity, mortality, health indicators (immunization status, opportune diagnosis, prevented deaths and diseases, etc) and health promotion to the Medical Care Benefits Directorate that support the decision-making process to allocate resources, infrastructure and investment in the IMSS.

Also they are considered an important reference to the health system in Mexico. These information systems provide information to other health institutions (SSA, ISSSTE, etc.) about immunization status, health interventions, and epidemiological surveillance of their populations.

Before this information is distributed to upper levels, all the epidemiological reports are reviewed and validated by the epidemiologist and ARIMAC service in each MCU; this procedure guarantees information with minimum quality standards.

The information systems in the IMSS have many sources and outputs; as a consequence they are huge and complex. More than half the data are entered and collected by hand and the reports are sent and distributed using official courier service.

Because of the complexity of the handled information, specific transmission channels have been generated that are the most appropriate but not necessarily the most efficient to reach the goal for which they were created.

Mechanisms of data transmission alternative to the traditional ones (written reports) have been performed, as phones notifications or fax to notify epidemiological emergency situations. These kinds of services increase the speed of data transmission with a high cost and make the process inefficient and less cost effective.

There is heterogeneity in collecting data. When there is not a standardized form to collect data each MCU designs its own form according to its needs. In this way there are MCUs that have a nominal census of each individual that receives a service from the public health department, but other services only collect the number of preventive care activities made per day. In both situations it is impossible to know the proportion of IMSS users for whom a screening test has been practiced. Because of that, a patient can do as many screening tests as he wants in the same year for the same program (diabetes, cervical cancer, etc.). It is obviously unnecessary and there is no capacity within the current health information systems to detect and correct this situation.

It is relative common that epidemiologists develop their own registries to monitor coverage, activities, supplies and notifications of epidemiological activities. Some of these registries are nominal, it’s means that in these forms they fill out patients’ data related with affiliation number, name, gender, age, screening and/or vaccines applied, etc. in order to feed the information systems or to notify patients’ family practitioner.

Also, these systems don’t allow us to know and locate the IMSS users that have never received a screening test and who are in high risk groups for developing, for example, diabetes mellitus or hypertension. With respect to the immunization program, it has made more advances in the recent years. Nevertheless with the current information systems it is not possible to know the true coverage of IMSS users; we only know the coverage of the general population (that includes the IMSS population and other health institutions).

Another serious limitation of the health information systems is that it does not allow us to know the number of patients with determinate diseases that are extremely important to the IMSS. For example, there is not a nominal registry that tells us the number of diabetes mellitus patients in the population covered by the IMSS, in spite of the fact that diabetes mellitus is one of the main causes of outpatient consultation, hospitalization and mortality. The same situation occurs with cancers and cardiovascular diseases.

Nowadays the process of data generation and sending is almost handmade. This causes information channels to become slow, incomplete, extemporaneous and quite often inopportune. But also because of its design the epidemiological information systems are closed systems that are complex, inflexible, bureaucratic and hierarchical, and don't allow effective interaction and feedback to the users.

During 2000 IMSS used 34 million doses of vaccines, provided 32,940,812 treatments, more than 23 millions of screening tests, almost one million health education activities and more than 36 million activities of surveillance and control of diseases under epidemiological supervision [(25)]. Nevertheless, it is not known who of the IMSS population received these health actions and whom did not. It is not possible to measure the health impact of all these activities because of the difficulties in handling all these data. With more than 30 million insured people in the IMSS, the quantity of information generated is of such magnitude that it makes it almost impossible to handle by hand or by rudimentary systematization.

All these weaknesses have as a consequence delays in information sending, reports duplication, inordinate consumption of time to collect and enter data (particularly in the medical care units), and loss of information during the procedures of entering, integration, sending and outcome. They also present problems to providing feedback to all the users with opportunity. These facts are reflected in the loss of opportunities to make decisions.

Another consequence of this situation is that sometimes epidemiologists have trouble doing comparisons of their data with others in similar epidemiological scenarios (local, state, and national). Then it is quite difficult for epidemiologists to do efficient evaluations of the impact of health programs and diseases under monitoring of epidemiological surveillance in their own communities.

One more paradox of the epidemiological information system is that not only public health personnel have limited access to databases, but also chairmen and heads of clinical department have limitations to use these data. As a consequence they are unable to do detailed evaluations of productivity, performance and efficiency in their services.

According to the situation previously exposed, it is obvious that there is a real necessity to find more efficient ways to analyze, evaluate and spread the epidemiological information in order to have opportune decision-making in all levels of medical care in terms of public health.

The current processes of the health reform in Mexico, and structural and organizational changes of the health institutions (in particular in the IMSS) should be linked to a substantial improvement of the medical information system, because promotes integral medical care with efficiency and quality to the population.

If an updated epidemiological information system is going to be developed in the IMSS, then epidemiologists could be considered as developers as well as users. This is an important reason to know their needs in epidemiological information.

Providers and medical organizations need to consider how applicable the evidence from an evaluation is to their own organization. To determine whether findings can be generalized for use in different organizations and situations, one should consider the characteristics of the patient population (demographics) and the characteristics of providers (culture, incentives, willingness to change or adapt). [(11)]

Ideally, evaluation should be designed at the conception of a system. Consumer needs and the desired effects of a system should be clearly specified prior to system implementation, so purchasers should ask to see this information. These desired effects should help define the outcomes of interest and evaluation design to carefully measure those outcomes. As presented elsewhere, initial stages of evaluation include specifying a problem or need of a particular target audience through need assessment. The results of this analysis are used to define the specifications for a product to address those needs.

Evaluations during product development include iterative usability testing to ensure that the product meets the needs of potential users with regard to usability and the facilitation of workflow or tasks. Component testing ensures that all aspects of the system perform accurately and meet design specifications. The final stage of evaluation is to actually measure outcomes during system use. However, a preliminary step usually involves a pilot evaluation to work out the implementation details of the evaluation and assessment tools. Quite often there are obvious misunderstandings of terms or unanticipated barriers that can be corrected before beginning the larger, more complete study. [11]

The epidemiologists in the IMSS are in key position in the health care system; they are the target population to ask about what their needs are and what their opinions are about how to improve the epidemiological information system.

The advantages to introducing a national health network in the IMSS are having an efficient mechanism for entering, transmission and analyzing epidemiological data, better retrieval information, notification, consultation of norms and procedures, as well as Internet and international database systems, e-mail, long distant education, teleconferences, and saving time, efficiency and costs.

The potential impact to the IMSS is more than evident; it does justify the necessity to have automated information systems that will promote financial savings in the mid and long term. On the other hand, the full standardization of the entering, analysis and quality control of the information procedures will promote on-time feedback, improving and efficiency to make decisions. All of this will produce direct benefits to the affiliated population.

To implement these changes it is necessary to incorporate new methods, techniques and instruments that allow us to know what are the health needs of the affiliated IMSS population, as well as to identify the priorities of care, research and health education.

The current process of structural changes in the IMSS, the disposition of the policy-makers to update technology infrastructure, as well as the current challenge of public health and human resources well disposed to finding better options to improve their performance, makes it imperative to assess about what are the needs of the epidemiological information systems in Mexico.

4. SPECIFIC AIMS

To explain epidemiologists' needs for epidemiological information in order to perform their activities.

To describe the pattern of use of the epidemiological information systems by the epidemiologists in their daily activities.

To explore epidemiologists' opinions towards the utilization of IHC applications.

Specific Aims

To analyze the pattern of utilization of the epidemiological information system.

To analyze possible relationships between the utilization pattern of the epidemiological information systems and background data.

To analyze possible relationships between the utilization pattern of the epidemiological information systems and work conditions and environment.

To analyze possible relationships between background data and work conditions and environment.

To assess the perceived needs of the epidemiological information system and background data.

To assess the relationship between the perceived desirability of IHC applications and background data.

To evaluate the impact of perceived desirability of IHC applications in the epidemiological information systems.

5. STUDY DESIGN AND METHODS

5.1. Design

Because epidemiological information systems have not been sufficiently used for the most potential beneficiaries and with a poor understanding of the epidemiologists' needs, one of the most suitable approaches for exploring and evaluating epidemiological information systems and the health providers' needs of these systems is a cross-sectional study.

5.2. Study population

The study population was epidemiologists from the whole country that were working in the Health Care Units, delegation and central levels of the Social Security Mexican Institute (IMSS).

5.3. Identification of cases

The target population was epidemiologists who were active workers at the time of data collection. They were identified through the Public Health (PH) Coordination database and with the collaboration of the Delegation Public Health coordinators

5.4. Questionnaire to health providers

Subject to a previous ethical approval and validation, an anonymous self-administered questionnaire was applied to the study population to explore their perceived needs of epidemiological information in the performance of job activities.

The questionnaire included open-ended and close-ended questions with multiple-choice options; some of them with Likert's scale or with more than one option to chose. It was solicited information on perceived needs of epidemiological information in the performance of job activities, educational level, and knowledge and beliefs of physicians regarding the utility of epidemiological information systems. In addition the questionnaire specifically asked about experience using computational equipment and epidemiological information systems allowing us to classify each subject in the level of previous experience, as well as about their opinions to use computational technology to handle the information systems.

Also the questionnaire included questions about socio-economic status of participants, job position, time in this position, computational equipment facilities in the workplace and suggestions to be included in the epidemiological information systems.

The questionnaire was divided into twelve sections; two of them explored participant information such as demographic data, and research and academic activities. Five sections addressed issues related to job conditions and environment; they are comprised of workplace description, work role activities, networks, communication between departments, and job design. Four sections were dedicated to assess the epidemiological information systems: health promotion activities, preventive medical care activities, epidemiological surveillance and epidemiological information systems. Finally, one section asked participants about the perceived desirability of computer applications in public health.

5.5. Definition and validation

As a first step to validate the questionnaire before data collection, we did a pilot test to correct potential errors in the instrument and in the design. We gave the questionnaire for review to two or three independent researchers and also we tested it with a group of IMSS epidemiologist students. Figure 11

Copies of Delegation PH coordinators' work addresses and phone numbers were requested from them and the PH coordination databases.

In general there was strong agreement among physicians about concepts of operational definitions of the epidemiological information system. Just a few subjects refused to participate in the survey without considering the importance of the information services.

We started the data collection on June 2002 at the same time the PH coordination and the Division of Medical Informatics were introducing a new information system to PH personnel. They organized regional training meetings in four places (Guadalajara, Mexico City, Torreon and Villahermosa). We were invited to attend these meetings and the organizers gave us room with the Delegation PH coordinators to explain to them the purpose of this study. We asked them for their participation and support in the delivery and collection of questionnaires to their epidemiologists, as well as to return of questionnaires through the official courier mail.

Two methods of data collection were applied; the first was meetings with Delegation PH coordinators in the regional training meetings in each region. All the sessions were done in conference rooms. We provided a brief explanation of the project and instructions to answer the questionnaire and gave them ninety minutes to respond it. In accordance with the number of epidemiologists registered in each delegation we gave delegation PH coordinators the same number of questionnaires to distribute to their colleagues. At the end of the session we gave them our thanks for their participation and support, and asked them to return the questionnaires in one package in no more than two weeks to the PH coordination offices in Mexico City using the official courier mail.

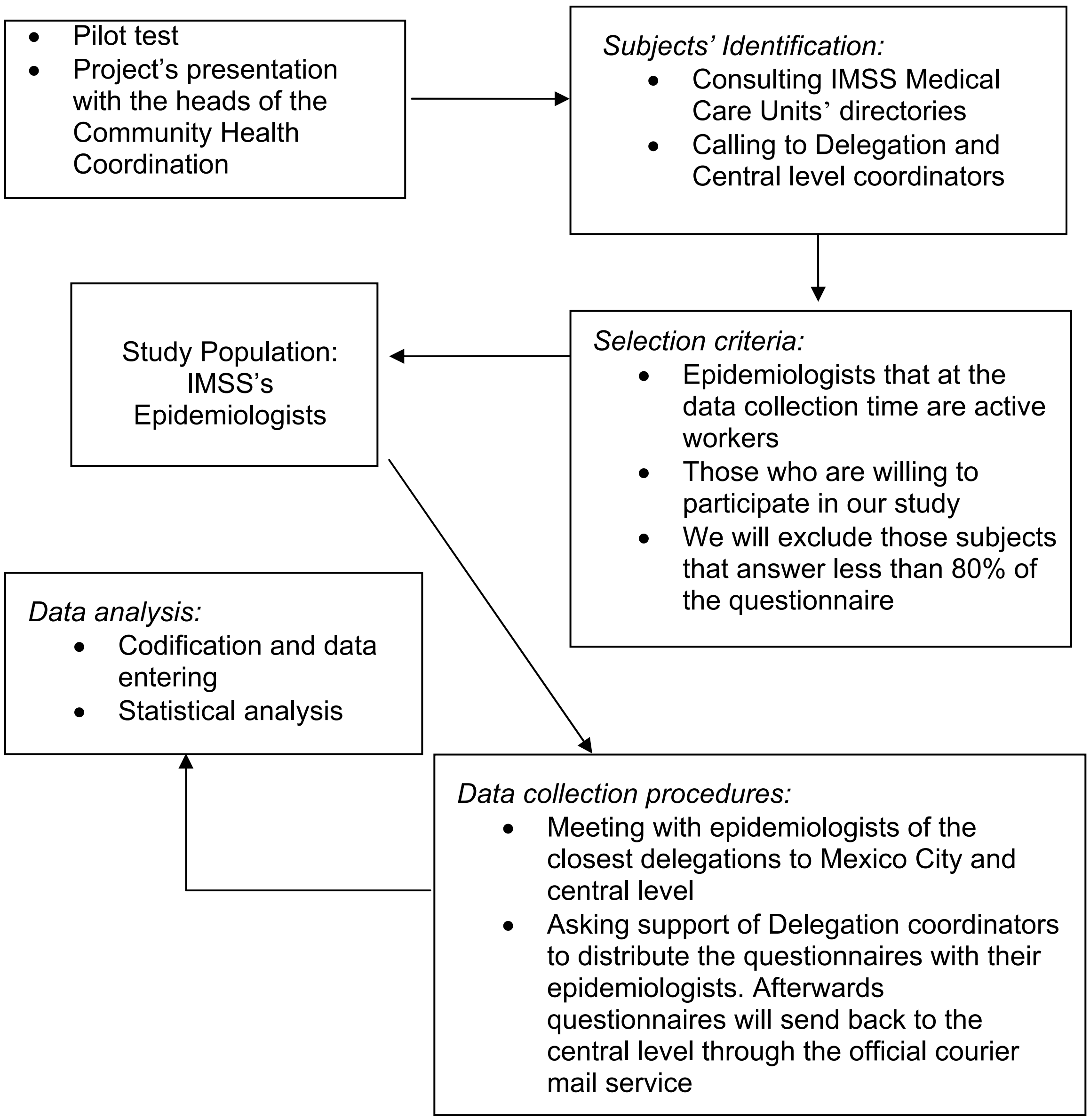

Figure 11. Design and Methods

The second method was applied to epidemiologists of the central level. First we met with the head of each division where after a brief introduction we invited them to participate and support our study. They allowed us to arrange meetings with their epidemiologists in conference rooms. All selected subjects were invited to participate, we explained to them the purpose of our study and those that agreed to participate asked to answer the questionnaire. At the end of the session we thanked them.

To assure the anonymity, we asked participants to put back the answered questionnaire in the envelope and return it according to the instructions given. Also all the questionnaires were delivered in closed envelopes and just for delivery purposes each package of questionnaires had an identification label on the outside with the Delegation epidemiologist's name and his or her workplace address.

After two weeks of questionnaire delivery in each region, we phoned Delegation PH coordinators to ask the status of their questionnaires and to return them if they were ready. Later every week and during one month we phoned them to remind them to return the questionnaires

Three months after the first questionnaire was distributed, there was a national meeting in Mexico City with PH personnel. We attended this meeting and met with Delegation epidemiologists, and we asked them one last time to send the remaining questionnaires and thank for their help.

One month latter we mailed to the delegation and central level epidemiologists a letter expressing our gratitude for their participation and support and asked them to share the content of these letters with all the participants. Also we let them know that at the end of this study we will send them a summary of results.

One month after the data collection, we started to design the code list and database, after which we began the questionnaires codifications. Two weeks later we started entering questionnaire data into the database, excluding those questionnaires that did not met our selection criteria. We finished this procedure three and a half months later.

We began the data analysis with an exploratory analysis to clean up the database, followed by a descriptive analysis and finally an analytic analysis. Separate analyses were carried out for epidemiologist participants by level of care (medical units, delegation and central level) in order to assess the potential impact of misclassification.

We had two informal meetings with the doctoral committee members to review results and define new directions of statistical analysis.

5.6. Selection criteria

We included those physicians that at the time of the data collection were active workers and those who were willing to participate in our study. We excluded those participants that answered less than 80% of the questionnaire.

5.7. Study Variables

5.7.1. Determination of perceived needs towards epidemiological information systems

For the purpose of this study we defined perceived needs of the epidemiological information system as "The felt epidemiologists' needs about the components of the epidemiological information systems". From the questionnaires of each participant we extracted questions that specifically explore epidemiological information systems needs (preventive medicine, health promotion, and epidemiology), such as opinions about the weakness and strengths of the information system, problems in handling, sending, and transmitting data, and feedback opportunities. Table 1

5.7.2. Perceived desirability of Interactive Health Communications (IHC) applications

To assess the knowledge and opinions of health care providers about automated information systems the following definition of perceived desirability of IHC applications was considered in this study: The felt epidemiologists' opinions towards the utilization of IHC applications. Table 1

5.7.3. Work conditions and environment

As work conditions and environment variables we used the description of work place, work role activities, network, and communication between departments and job design. Table 1

5.7.4. Background or Demographic variables

The following background variables were included in this study: age, gender, marital status, education, job position, and academic and research activities. Table 1

5.8. Assessment of relationships variables

The twelve questionnaire sections allowed us to reorganize the study variables into six indices: Demographics, workplace and infrastructure, work environment, research and academic activities, epidemiological information systems and desirability of computer applications. After the exploratory analysis we selected some variables of each index, recoded and ran again some descriptive procedures.

Under the nulls hypothesis "Epidemiologists who have access to information technology (computer, e-mail or Internet) have better opinion toward the epidemiological information systems (EIS), work environment (WE) and desirability of computer applications (DCA)", we did an analytic analysis to explore possible relationships between EIS, WE and DCA and some demographic variables like age, gender, job position, time in job position and time working in the IMSS. Separate analyses of this analytic procedure were done by level of care.

From this analysis we selected those variables that showed more association and built new indices to search for differences between groups between those who have access to information technology and EIS, WE, DCA to assess if access to information technology influenced epidemiologists' opinions towards the utilization of interactive health communication (IHC), epidemiological information systems and research and academic productivity.

To perform this analysis we recoded again some variables and created new variables. With eight variables from desirability of computer applications we built two indices: Computer applications (patient care, medical decision-making, and physician substitute) and consequences of the use of computer applications (cost & quality, epidemiologists autonomy, physician role, medical manpower and organization).

Also we built two indices called information technology (computer at work and/or e-mail and/or Internet access) and Internet tools (e-mail and/or Internet access). From research and academic activities we just picked up three variables: “current research activities”, “published articles” and “have students”. Variables selected from epidemiological information systems were: accuracy of information system, notification forms, notification channels as well as feedback, reports and health promotion activities.

5.9. Sample Size and Data analysis

5.9.1. Data analysis

All the questionnaires were codified and entered in a designed database in Microsoft Excel software. Subsequently we did the statistical analysis in SPSS software. Exploratory analyses were carried out with all the study variables to clean up and prepare the database to analyze it.

Initially we undertook a series of descriptive analyses for each variable using frequencies, percentages and percentiles as distribution measures, and media, mode, means, standard deviation as dispersion measures. We recorded some variables and ran contingency tables, and crude odds ratio with a 95% confidence interval. Those variables that showed more association were selected to apply standardized residuals analysis to assess differences between the observed values and the values expected under the null hypothesis.

Table 1. Variables definition

Variables	Definition	Indicator	Category	Scale
Perceived needs of the epidemiological information system:	The felt needs about the epidemiological information system	What epidemiologist express as opinions about components of the epidemiological information system		
Epidemiological information system	pattern of utilization to enter, transmission, feedback of Epidemiological information system	Epidemiologists' description of their pattern of utilization of epidemiological information system	Qualitative, nominal Quantitative discrete	Yes=1, No=2 X=0-Time
Epidemiological surveillance system	Notification system of diseases under epidemiological surveillance	Epidemiologists' description of their pattern of utilization of epidemiological surveillance system	Qualitative, ordinal	1= strongly disagree to 7=strongly agree Likert scale
Health promotion	Epidemiologists' description of health promotion activities		Qualitative, nominal	
Preventive Medicine	Epidemiologists' description of preventive medicine activities		Qualitative, nominal Quantitative discrete	Yes=1, No=2 X=0-Time
Perceived desirability of IHC applications:	The felt epidemiologists' opinions towards the utilization of IHC applications			Likert scale
Work condition and environment:	Epidemiologists' description of their work conditions and environment			

TABLE 1. (CONTINUED)

Variables	**Definition**	**Indicator**	**Category**	**Scale**
Work place	Description of the workplace and resources available			Yes=1, No=2
Work role activities	Epidemiologists' description of how they spend their time at work		Quantitative, discrete	X=0-Time
Network	Description of how the epidemiologists' job are related to other jobs		Qualitative	Time frequency
Communication between departments	It is the communication between epidemiologist and other departments in the workplace		Categorical	Time frequency
Job design	Epidemiologists' opinion about the freedom to organize their job activities		Qualitative, ordinal	1= strongly disagree to 7=strongly agree Likert scale
Background variables:	Variables related with demographical data and academic and research background			
Age	Date of birth			day-month-year
Gender	Female or male		Categorical	Female=1,Male=2
Marital status			Categorical	Married Not married but living with a sexual partner Separated Divorced Widowed Never married Refused

TABLE 1. (CONTINUED)

Variables	**Definition**	**Indicator**	**Category**	**Scale**
Education	Epidemiologists' academic degrees		Categorical	Diplomas, specializations, masters and doctoral degrees
Job position	Current position in the work place and time in this position		Categorical	Epidemiologist at PCU Epidemiologist at GH Epidemiologist at NMC Epidemiologist at delegation level Epidemiologist at central level
Academic activities	Teachings and training activities to other medical personnel		Qualitative, nominal	Yes=1, No=2
Research activities	The scientific activities that have been performed by the epidemiologists		Qualitative, nominal	Yes=1, No=2

5.9.2. Sample size

We included all the epidemiologists (approx. 501) in the IMSS medical care centers. For this reason sample size calculation was not needed.

5.10. Ethical approval

This proposal was submitted to the Institutional Review Board of the University of Pittsburgh, as well as to the Scientific and Ethical Advisory Committee of the IMSS, who is the authority in charge to provide copyright; this committee gave us the authorization to access all the medical care centers and databases within the IMSS.

6. RESULTS

6.1. Population study

From June to August of 2002 we distributed 501 questionnaires among all epidemiologists of the Mexican Institute of Social Security (IMSS). We received back 476 questionnaires; from those we excluded 19 because they didn't meet our selection criteria. In the end we got 467 questionnaires and a respond rate of 93%.

Our study population was conformed by 162 females (34.7%) and 305 males (65.3%). This distribution was more or less the same in all levels of care with the exception of delegations' epidemiologists where the majority were men and central level where the proportion of women was higher than men (Tables 1, 2). Age mean was 46.56 (±5.92), minimum and maximum ages were 30 and 63 years old, age distribution was uniform among levels of care (table 3). Most of the participants were married 77.1%, only 6 subjects refused to answer their marital status. Table 2

Almost the whole population consisted of physicians (464/ 99.4%); two were engineers and one biologist. Most of them were from the following universities: National Autonomous University of Mexico (UNAM) (156/33.4%), University of Veracruz (UV) (46/ 9.9%), National Polytechnic Institute (IPN)(34/7.3%), University of Puebla (19/ 4.1%), and University of Yucatan (UY) (17/3.6%). In all levels of care the UNAM was the most common school cited, followed by the UV and IPN.

In relation with graduate studies from 467 participants 8 were MD (1.7%), 218 had a medical specialization (46.7%), 225 had a master and/or PhD degrees (48.2%) and 16 had some unfinished degree (3.4%) (Table 2). The most frequent fields of graduate studies were in public health, epidemiology, family medicine, medical sciences and hospital management. Specialization in public health, epidemiology and family medicine were the most frequent fields in all care levels, in particular in first and second level. The most frequent master degrees fields were in public health, epidemiology and health administration. There were 9 epidemiologists with PhD degrees in fields related to health administration, epidemiology, social medicine and medical education.

Currently 48% epidemiologists are working in primary care units (PCU), 27% in General Hospitals (GH), 4.5% in National Medical centers (NMC), 14.8% in Delegations (DEL) and 5.8% in the central level (CL). On average they have been working with the IMSS 12.66 years (±5.79) and they have been performing their current position 7.86 years (±6.02). Epidemiologists from national medical centers and delegations were the ones with more time working in the IMSS 14.27 ±6.59 and 15.23 ±4.95 respectively; 42% of the epidemiologists have been working between 10.01-15 years and 20.8% between 15.01-20 years. PCU Epidemiologists have been working more time in their current position (8.94 ±6.05 yeas) followed by national medical centers (8.32 ±6.88); 27% epidemiologists have between 1.01-5.0 years in this position and 25.9% between 10.01-15 years, most of them were in first and second levels of care. Tables 2-4

Table 2. Demographic variables

Concept	Number	Percent
Gender		
Female	162	34.7
Male	305	65.3
Age		
30-39	55	11.8
40-49	277	59.3
50-59	128	27.4
60+	7	1.5
Marital status		
Married/Free union	360	77.1
Divorced/Separated	44	9.5
Widow	1	0.2
Single	56	12.0
Refuse answer	6	1.3
Professional studies		
Colleague	8	1.7
Specialization	218	46.7
Master/Doctorate	225	48.2
Some graduate studies	16	3.4
Graduate studies fields		
Public health	344	65.15
Epidemiology	126	23.86
Hospital management	12	2.27
Family medicine	25	4.73
Medical sciences	12	2.27
Pediatrics	9	1.7
Job position		
Primary care unit	224	48
General hospital	126	27
National medical center	21	4.5
Delegation	69	14.8
Central level	27	5.8

Table 3. Demographic variables by level of care

	Primary Care Units	General Hospitals	National Medical Centers	Delegations	Central Level
Gender					
	81 (36.2%)	47 (37.3%)	7 (33.3%)	14 (20.3%)	13 (48.1%)
Female	143 (63.8%)	79 (62.7%)	14 (66.7%)	55 (79.7%)	14 (51.9%)
Male					
Age grouped					
30-39	26 (11.6%)	19 (15.1%)	2 (9.5%)	5 (7.2%)	3 (11.1%)
40-49	130 (58.0%)	71 (56.3%)	11 (52.4%)	44 (63.8%)	21 (77.8%)
50-59	67 (29.9%)	33 (26.2%)	7 (33.3%)	18 (26.1%)	3 (11.1%)
60+	1 (0.4%)	3 (2.4%)	1 (4.8%)	2 (2.9%)	0
Professional studies					
Colleague	5 (2.2%)	2 (1.6%)	0	0	1 (3.7%)
Specialization	110 (49.1%)	65 (51.6%)	5 (23.8%)	27 (39.1%)	11 (40.7%)
Master/Doctorate	102 (45.5%)	55 (43.7%)	16 (76.2%)	40 (58.0%)	12 (44.4%)
Some graduate studies	7 (3.1%)	4 (3.2%)	0	2 (2.9%)	3 (11.1%)
Current position time (years)					
0.01-1.0	23 (10.3%	18 (14.3%)	2 (9.5%)	7 (10.1%)	4 (14.8%)
1.01-5.0	43 (19.2%)	42 (33.3%)	6 (28.6%)	30 (43.5%)	5 (18.5%)
5.01-10.0	58 (25.9%)	25 (19.8%)	6 (28.6%)	13 (18.8%)	9 (33.3%)
10.01-15.0	68 (30.4%)	30 (23.8%)	2 (9.5%)	14 (20.3%)	7 (25.9%)
15.01-20.0	21 (9.4%)	8 (6.3%)	4 (19.0%)	3 (4.3%)	2 (7.4%)
20.01+	11 (4.9%)	3 (2.4%)	1 (4.8%)	2 (2.9%)	0
IMSS working time					
0.01-1.0	6 (2.7%)	3 (2.4%)	0	0	2 (7.4%)
1.01-5.0	20 (8.9%)	14 (11.1%)	3 (14.3%)	3 (4.3%)	2 (7.4%)
5.01-10.0	36 (16.1%)	26 (20.6%)	1 (4.8%)	3 (4.3%)	3 (11.1%)
10.01-15.0	101 (45.1%)	52 (41.3%)	7 (33.3%)	28 (40.6%)	8 (29.6%)
15.01-20.0	40 (17.9%)	16 (12.7%)	6 (28.6%)	25 (36.2%)	10 (37.0%)
20.01+	21 (9.4%)	15 (11.9%)	4 (19.0%)	10 (14.5%)	2 (7.4%)

Table 4. Age, time in the current job position and time working in the IMSS working (years) by level of care

	Age			Job position time			IMSS working time		
	M *	**SD**	**Md**	**M**	**SD**	**Md**	**M**	**SD**	**Md**
Primary Care Units	46.36	±5.6	47	8.94	±6.0	9.06	12.22	±5.6	12.07
General Hospitals	46.8	±6.3	47	6.92	±5.9	5.02	11.78	±5.9	11.10
National Medical Centers	47.5	±7.4	48	8.3	±6.9	7.02	14.3	±6.6	14.0
Delegations	47.4	±5.6	47	6.3	±5.5	5.0	15.2	±4.9	15.03
Central Level	44.1	±5.3	44	6.9	±5.1	8.0	12.5	±6.2	13.11

* M= median, SD=Standard deviation, Md=Median

6.2. Workplace and Infrastructure

6.2.1. Workplace

Primary care units had more user population than others care units, mostly between 50-100,000 users in each unit. In contrast general hospitals on average had between 20-50,000 users. Epidemiologists from national medical centers didn't answer this question; it is difficult for them to calculate user population because their centers receive people from different delegations and this number is not constant.

The average distance from the epidemiologists' workplace to their public health (PH) supervisor was 129.91 Km (±318.106). Those who walked to see their boss spent on average 6 minutes walking, and those who used a car or bus spent around one hour; other kinds of transportation were less frequent.

For 20.1% of the study population, the distance from the workplace to the immediate PH coordinator was 1-4.99 km, 19.1% epidemiologists were between 100-499.99 km and 16.5%

were 0.01-0.999 km. From 224 epidemiologists working in primary care units 28.6% were between 1-4.99 km distances of their immediate PH coordinator. In the second level of care 30.2% were between 100-499.99 km. 33.3% epidemiologists of national medical centers were 1-4.99 km from their PH supervisor, 37.7% of delegation epidemiologists were 500 or more km and all the epidemiologists at the central level were between 0.01-4.99 km from their immediate supervisor.

The most frequent transportation used in the first and second levels of care by epidemiologists from their medical care unit (MCU) to see their immediate PH supervisor was car, bus and feet. In the third level were car and feet. To the DEL were bus, car and plane and to the entire epidemiologists of CL was by foot.

On average there were 10.47 (±6.12) people working in each public health (PH) service. In primary care units the most frequent number of personnel working were 11-15 people (77/34.4%), in the second level of care were between 6-10 people (42/33.3%), in the third level was 1-5 people (17/81%) and in the delegation and central level was 6-10 people 36 (52.2%) and 18 (66.7%) respectively.

In each MCU the average of people working in public health departments consisted of 1.29 (SD .95) epidemiologists, 1.39 (±0.76) specialized nurses in public health, 0.64 (±1.34) general nurses, 4.07 (±4.36) auxiliary nurses and 0.73 (±0.94) office assistants.

In PH services of all levels of care the most common situation was to find one epidemiologist (366/78.4%), one public health (PH) nurse (204/43.7%), no general nurse (321/68.7%), four auxiliary nurses (183/39.2%), one secretary (224/48.0%) and no one entering data personnel, statisticians and codifiers. Table 5

Table 5. Personnel in public health departments

PH personnel	0	1	2-5	6-10	11 +
Epidemiologists	10 (2.1%)	366 (78.4%)	87 (18.6%)	3 (0.6%)	1 (0.2%)
Public health nurses	52 (11.1%)	204 (43.7%)	211 (45.2%)	0 (0%)	0 (0%)
General nurses	321 (68.7%)	77 (16.5%)	60 (12.8%)	9 (1.9%)	0 (0%)
Auxiliary nurses	135 (28.9%)	35 (7.5%)	154 (32.9%)	107 (22.9%)	36 (7.7%)
Auxiliary office assistants	203 (43.5%)	224 (48.0%)	37 (7.9%)	3 (0.6%)	0 (0%)

Sixty-seven percent (150) of PCUs had in PH services 2 PH nurses; one PH nurse in 53.2% (67) of GH, as well as in NMC (17/81%), DEL (61/88.4%) and CL (8//29.6%). In PCU the most frequent number of PH nurses was two (150/67.0%), to others levels was just one PH nurse and just a few PH services in 1-3 level don't have any PH nurse.

Most of PH services in each level of care didn't have a general nurse (58.9-100%). To have auxiliary nurses was a relatively common in the first and second levels of care: 218 (97.3%) and 92 (73%) respectively. Lack of a secretary was the common denominator in the first three levels of care: 58.5%, 44.4% and 61.9% respectively, in contrast in delegations and the central level the most frequent number of secretaries was one per service (62.3% and 77.8%). Entering data personnel, statisticians and codifiers were not a common type of personnel in all levels of care.

Seventy-eight percent epidemiologists had their own office: 77.7% from PCU, 84.1% from GH, 76.2% NMC, 78.3% DEL and 55.6% CL.

6.2.2. Infrastructure

From 467 epidemiologists only 282 (60.6%) had personal computers (PC) at work. In the first level of care 126 (56.3%) epidemiologists had PC's, in contrast in the central level 24 (88.9%) epidemiologists had PC's and in delegations 61 (88.4%) epidemiologists. Table 6

From those epidemiologists who had PC's in their workplace, 185 had PC Pentium models and 65 had older models (286-486 processors). From 98 epidemiologists in the first level who had PC's there were 36 (36.7%) epidemiologists who had PC's with processors 286-486 and, in the second level of care there were 19(24.1%) of 83 in the same situation. In contrast of 16 epidemiologists in national medical centers, 13 (81.3%) had PC Pentiums, as well as 86.9% epidemiologists from delegations and 95.8% from the central level. Table 6

The IMSS was the owner of 244 (86.52%) computers and 35 epidemiologists used their own computers in the workplace. In the first (17.3%) and second levels of care (12.0%) epidemiologists brought their own computers to work.

In each PH department on average there were 1.52 (±1.72) people using these computers. From 282 epidemiologists who had PC's, 136 (48.2%) were the only ones in their department who used these PC's; in contrast 132 (46.8%) epidemiologists shared the PC's with other PH personnel. This pattern was common in the first level (49.0% non-share and 43.9% share) but it wasn't in other levels where the PC's were mainly shared with other PH personnel: 59% in general hospitals, 68.8% national medical centers. In the delegations and central level, epidemiologists were the only personnel who used these computers, 55.7% and 83.3% respectively.

Table 6. Information technology infrastructure

Concept	Number	Percent
PC at workplace		
Yes	283	60.6
No	184	39.4
Computer processor type		
PC286	7	2.48
PC386	19	6.77
PC486	38	13.47
Pentium	185	65.6
Mac	1	0.35
Don't know	11	3.90
Other	21	7.45
Communication technologies facilities		
Phone	456	97.6
Cell phone	54	11.6
Beeper	1	0.2
Fax	274	58.7
Voice mail	6	1.3
E-mail	103	22.1
FTP	72	15.4
Telnet	0	0
Chat rooms	2	0.4
Mail	30	6.4
IMSS mail	326	69.8
Mail (DHL)	47	10.1
Other	23	4.9
E-mail access in workplace		
Yes	104	22.3
No	363	77.7
Internet access in work department		
Yes	165	35.3
No	302	64.7
Internet facilities available		
E-mail	97	39.27
Telnet	2	0.81
FTP	65	26.31
WWW	27	10.93
Don't know	5	2.02
None	51	20.64

From 282 people who had PC's at work 82 (29.1%) epidemiologists were the only ones who used it; seventy (27.0%) shared the PC with another person, sixty-seven (23.8%) people with two people and, 55 (19.5%) with three or more people. In PCU only 30.6% of the epidemiologists who had PC's were the only ones who used it, the other 69.4% shared the PC with at least one person in their service. In general hospital was 20.5% vs. 79.5%, in the third level of care all epidemiologists shared the PC with other personnel. In delegations 68.5% epidemiologists shared the PC and in the central level 66.7% epidemiologists were the only ones who used the PC.

The most frequent communication technologies available in each level of care were phone 97.6% (476), IMSS mail 69.8% (326), fax 58.7% (274), e-mail 22.1% (103), FTP 15.4% (72), and mail post 6.4% (Table 6). In the first level the most frequent were phone 96%, IMSS mail 70.5%, fax 46% and e-mail 6.3%. General hospitals had phone 100%, IMSS mail 70.6%, fax 67.5% and e-mail 15.9%; the third level had phone 95.2%, IMSS mail 61.9%, fax 42.9% and e-mail 4.8%; epidemiologists from delegations had phone 98.6%, fax 89.9%, IMSS mail 76.8% and e-mail 68.1%. In the central level 100% of the epidemiologists had phone, 77.8% e-mail, 55.6% fax and 48.1% IMSS mail. FTP was available only to 71% (49) of delegation's epidemiologists and 70.4% central level epidemiologists. Courier services were mainly used by the delegations (27.5%). Telnet, chartrooms, voice mail, beepers were unavailable communications technology in any level of care.

Only 104 (22.3%) people had e-mail access in the workplace (Table 6). From them 16 (7.1%) epidemiologists of PCU had e-mail access, 27 (21.4%) from GH and only one (4.8%) in the third level of care. Delegations' epidemiologists had more e-mail access than other epidemiologists (48/69.6%) followed by the central level with 12 (44.4%).

One hundred sixty-five (35.3%) epidemiologists said that they had Internet access in their departments; in the first level there were just 12.5% but in the upper levels the internet access increased significantly: general hospitals 38.1%, third level 47.6%, delegations 82.6% and central level 81.5%. Table 5

The most frequent Internet facilities were e-mail (97/20.8%) and FTP (65/13.9%). Eighteen of twenty-eight of PCU epidemiologists who said that they have Internet access in their workplaces didn't have any Internet service in their department, similar situation was reported by 26(55.3%) epidemiologists from general hospital and 7(70.0%) epidemiologists from third level. In contrast, in the central level and delegation epidemiologists said they had e-mail access in their departments (89.5% and 95% respectively). Access to WWW was available in delegations (21.2%) and in the central level (28.6%). Table 6

6.3. Work environment

6.3.1. Work activities

Epidemiologists from the three first levels work 6 and a half hours daily and epidemiologists from delegations and the central level 8 hours. On average all of them spent their workday mainly doing four activities: data processing (1.26 hrs, ±1.33), talking with patients (1.25 hrs, ±1.08), attending meetings (1.16 hrs, ±1.3) and filling out forms (1.08 hrs, ±0.94). Proportionally 27.6% spent 30 minutes of their work day talking with colleagues, 26.8% one hour doing data processing and 26.6% spent one hour doing external administrative tasks. Eighty-five percent described their workday time as a typical or very typical. Table 7

By type of work activities epidemiologists spent their time as follows: 62.5% spent between 1-30 minutes talking on the phone but 37.7% epidemiologists from delegations spent between 31 minutes to one hour. Filling out forms, 54.2% epidemiologists from all care levels spent between

31 minutes to two hours; in contrast 66.7% epidemiologists from central level didn't spend any time in this activity. 29.8% epidemiologists spent between 1.01-2.0 hours talking with patients, mainly epidemiologists from PCU (43.8%), GH (27%) and NMC (33.3%) and 22.3% didn't spend any time, mainly from delegations (85.5%) and central level (88.9%).

Thirty percent of epidemiologists from all care levels didn't spend any time doing external administrative tasks and 28.3% spent around 31 minutes to one hour (31.9% from delegations and 31.7% from GH). 42.2% epidemiologists didn't spend time helping others to get information; in contrast 30.4% used between 1-30 minutes helping people mostly from PCU (37.5%), GH (27.0%) and delegations (24.6%). Also 20.6% epidemiologists spent between 31 minutes to one hour (28.6% NMC, 29.0% delegations and 29.6% central level). Almost 46% spent 1-30 minutes talking with colleagues, and 31% didn't spend any time (33.9% PCU, 30.4% delegations and 44.4% central level).

From all levels of care 54.2% of epidemiologists spent 0.31-2.0 hours doing data processing. The exception was 44.4% of central level epidemiologists who spent more than 4 hours of their work time. 53.5% epidemiologists didn't spend any time walking in the MCU (81.2% delegations and 85.2% central level) but in contrast 37.7% used between 1-30 minutes walking, mainly epidemiologists from PCU (44.6%), GH (39.7%) and NMC (52.4%). From all care levels 47.9% epidemiologists spent between 0.31-2.0 hours attending meetings (50.0% GH, 71.4% NMC, and 59.4% delegations), but also 29.6% epidemiologists didn't spend any time in meetings (40.2% PCU, 24.6% GH, 25.9% Central level)

Table 7. Work activities: Workday activities (hours)

Concept	M	SD	Md	Min-max
Phone calls	0.33	.48	0.20	0-3
Filling forms	1.08	.94	1.00	0-4
Talking with patients	1.25	1.08	1.00	0-6
External administrative tasks	0.84	1.03	0.30	0-6.3
Helping others	0.40	0.62	0.20	0-6
Talking with colleagues	0.38	0.52	0.30	0-4
Data processing	1.26	1.33	1.00	0-8
Walking	0.18	0.37	0.00	0-3
Attending meetings	1.16	1.3	1.00	0-9

* M= median, SD=Standard deviation, Md=Median, Min-Max=minimum-maximum

Table 8. Work activities: Workweek functions (%)

Concept	M	SD	Md	Min-max
Data analysis	23.56	15.36	20.00	0-100
Planning and evaluation	15.35	11.09	15.00	0-90
Coordination	19.98	13.87	20.00	0-100
Advising colleagues	11.94	9.09	10.00	0-80
Research activities	4.65	26.78	0.00	0-50
Teaching and training activities	11.32	11.82	10.00	0-100
Supervision	14.01	10.22	10.00	0-90

* M= median, SD=Standard deviation, Md=Median, Min-Max=minimum-maximum

By level of care epidemiologists' work activities were as follows: on average in primary care units epidemiologists used their time mainly talking with patients (1.67 hrs), filling out forms (1.28 hrs.) and doing data processing (0.59 minutes). 28% spent one hour filling out forms, 29.9% 2 hours talking with patients and 27.7% thirty minutes talking with colleagues.

In general hospitals epidemiologists spent an average of 1.36 hours talking with patients, 1.01 hours doing data processing and 1.21 hours attending meetings. Proportionally 29.4% of epidemiologists spent one hour doing administrative external tasks, 30.2% used thirty minutes to talk with colleagues and 30.2% one-hour processing data.

Epidemiologists from national medical centers on average invested 1.21 hours to talk with patients, 1.28 hours to process data and 1.20 hours to attend meetings. 33.3% epidemiologists spent 30 minutes talking with colleagues, 38.1% attending meetings and 23.8% one-hour filling out forms.

On average epidemiologists from delegations spent 1.65 hours doing external administrative tasks, 1.63 hours with data processing and 1.95 attending meetings. 33.3% epidemiologists used one hour filling out forms, 31.9% one hour doing external administrative tasks, 36.2% two hours processing data and 31.9% two hours attending meetings.

In the case of central level epidemiologists, on average they spent 1.25 hours doing external administrative tasks, 3.67 hours with data processing and 1.48 attending meetings. 33.3% epidemiologists spent thirty minutes talking on the phone, 14.6% four hours doing data processing and 22.2% two hours attending meetings.

Epidemiologists from all care levels distributed their workweek mainly into four functions: data analysis (23.56%, ±15.36), epidemiological activities coordination (19.98%, ±13.87), planning and evaluation (15.35%, ±11.09) and supervision (14.01%, ±10.22). Research activities were the function to which they assigned less time (4.65%, ±6.78) (Table 8). From 100% time function distribution 35.5% epidemiologists used 10% of their time giving advise to colleagues, 32.2% spent 10% of the time teaching, 31.3% epidemiologists used 20% of their time in data analysis and 28.1% invested 20% of time coordination. This distribution of functions was performed in a typical or very typical workweek by 87.6% epidemiologists.

All epidemiologists distributed their functions as follows: 65.3%(305) epidemiologists gave 1-25% of their time in data analysis but 37% of the epidemiologists from the central level used 25-50% of their time. In planning and evaluation 375(80.3%) epidemiologists invested between 1-25% of their time. They spent between 1-25% of their time in coordination (71.5%/334) but also 44.4% epidemiologists from the central level didn't spend any time in this function. Epidemiologists from all levels of care used between 1-25% of their time advising (383/82%). 50.1%(234) epidemiologists from all care levels didn't spend any time in research; in contrast 222(47.5%) epidemiologists invested between 1-25% of their time in research, mainly epidemiologists from PCU (49.6%), NMC (61.9%) and delegation (46.4%). In teaching 74.1%(346) epidemiologists used between 1-25% time and 19.3%(90) epidemiologists didn't spend any time teaching, mostly in delegations (30.4%) and in the central level (44.4%). On supervision 80.3%(375) epidemiologists invested 1-25% time but 66.7% epidemiologists from the central level didn't spend any time in supervision.

In first level of care the main functions performed by epidemiologists were data analysis (21.52%), coordination (20.51%) and supervision (15.17%). 37.1%(83) epidemiologists spent 32% of time in data analysis, 34.8%(78) 10% time teaching and 33.5%(75) 10% time in supervision.

The main functions performed by epidemiologists from general hospitals were data analysis (24.07%), coordination (21.9%) and planning and evaluation (14.77%). 39.7%(50) spent ten percent of their time providing advise, 31.7%(40) coordinating and 31.7%(40) in supervision.

Epidemiologists from national medicals centers distributed their time mostly in the following functions: 29.05% data analysis, 14.95% teaching and 14.67% coordination. 28.6% NMC epidemiologists used 10% of their time advising, 28.6% spent 10% of time supervising and 28.6% used 5% of time researching.

In delegations epidemiologists distributed their time performing the following functions: 22.88% data analysis, 20.78% in coordination and 15.81% in planning and evaluation. Proportionally 36.2% epidemiologists spent 20% of their time in data analysis, 31.9% used 20% of the time in planning and evaluation, 40.6% used 10% of the time providing advise.

Epidemiologists from the central level distributed their time in data analysis (35.48%), planning and evaluation (25.41%) and advising (11.33%). Thirty-seven percent of epidemiologists spent 10% of their time in planning and evaluation, 37% spent 10% advising and 29.6% used 10% of their time teaching.

6.3.2. Networks

The frequency of how often epidemiologists meet with other personnel in their MCU to discuss their performance was as follows: At least every month they used to meet with the chairman (39.2%/163) and administrator (48.5%196) of their MCU in both cases. These meetings were mainly in PCU (41.5%/47% respectively), GH (40.2%/59.7%) and delegations (33.0%/34.0%). Also at least one monthly discussion was done with archives personnel (31.9%) and heads of clinic departments (39%) in both cases with the exception of the central level epidemiologists. Monthly meetings were done with health promotion personnel (30.9%/125); this happened mainly with epidemiologists from PCU (33.2%) and delegations (37.7%) and no discussions (26.7%) at all in GH (32.2%) and NMC (43.8%).

Epidemiologists meet at least one time per week with ARIMAC personnel (33.4%/136) and 31.4% (128) at least one time per month with the exception of central level epidemiologists. With their PH supervisor (47.0%) said they meet at least one time per month in all levels of care, 28%(124) epidemiologists never met with their PH supervisor. But also 19% epidemiologists met their supervisor at least one time per week especially in delegations (18.8%) and the central level (33.3%). With other epidemiologists in the same position as them 36.4% epidemiologists met at least one time per month and 28% (124) never meet with other epidemiologists; in particular this situation happened in the central level (36.4%). Table 9

Finally 34.1% epidemiologists from all levels of care discussed epidemiological issues with nurses at least one time per month but also 27.1% epidemiologists meet one to several times per day with nurses, in particular in PCU (30.1%), GH (23.2%) and delegations (32.1%). Table 9

Table 9. Networks with other departments to discuss epidemiological issues (%)

Personnel/ Frequency (%)	None	1 or several times/month	1 or several times /week	1 or several times /day	No applicable
Chairman	19.7	34.9	25.3	9.2	10.9
Administrator	22.9	41.9	17.8	3.8	13.5
ARIMAC	20.1	27.4	29.1	10.5	12.8
Achieve	28.5	26.4	19.5	8.3	17.3
Nurses	15.8	31.0	19.5	24.6	9.0
Head clinic departments	16.5	33.6	22.3	13.8	13.9
Health promotion	23.1	26.8	18.2	8.4	13.5
Supervisor	26.6	44.5	18	5.8	4.9
Epidemiologists	31.0	41.1	12.2	5.4	9.6

Table 10. Communication between departments: Meetings frequency with colleagues to talk about epidemiological issues (%)

Personnel/ Frequency (%)	Never	1 or less time /month	1 or several times /week	1 or several times /day	Many times /day	Don't know	No applicable
PH nurse	3.6	0.2	23.8	45.6	18.6	0.2	7.9
Health promotion	7.1	0.2	37.2	35.6	6.0	0.2	13.7
ARIMAC	6.6	0.6	51.6	26.8	2.6	0.9	10.9
Head clinic departments	7.1	0.4	51.6	22.1	1.5	0.2	17.1
Laboratory head	9.0	0.4	55.9	14.4	0.9	0.6	18.8
Achieve head	13.7	0.4	49.7	15.4	0.9	1.1	18.8
Supplies head	18.6	1.1	55.0	7.5	0.4	1.3	16.1
Nurses	5.4	0.9	47.9	29.1	6.4	0.6	9.6
Chairman	5.8	0.8	51.9	27.6	3.4	0.4	10.1
Supervisor	17.1	6.5	50.9	4.9	0.6	2.1	17.8
Epidemiologists	17.3	7.3	50.4	3.2	0.4	2.6	18.8

6.3.3. Communication between departments

About how often epidemiologists met with personnel of other departments in their workplaces to talk about epidemiological issues, we found that, from 430 epidemiologists 241 (52.2%) met one o more times per day with public health nurses. With health promotion personnel they met one time per week (43.2%) and one time per day (25.6%). This situation was more often seen with PCU epidemiologists (26.8%). 57.9% epidemiologists met in their workplace with ARIMAC personnel one time per week, with the exception of people from the central level. 62.3% epidemiologists from all care levels (except central level) met one time per week with the head of clinic departments. The same situation was with the head of the laboratory (68.9%), archives personnel (61.3%), supplies personnel (65.6%), and chairman (57.6%). Table 10

Fifty-three percent of epidemiologists met one time per week with nurses and 27% met several times per day with the nurses (mainly epidemiologists from PCU 34.8%) and GH 21.5%). With other epidemiologists 62% epidemiologists used to meet one time per week and zero times for 20.8%, mainly in delegations (31.6%) and the central level (55.6%). 62.0% epidemiologists from all care levels met one time per week with their immediate PH supervisor but 18% of delegation epidemiologists and 40.7% from the central level answered as not applicable this option.

To talk about epidemiological issues in general epidemiologists from all levels of care met more often with PH nurses (several times per day), head of the laboratory, supplies personnel, other epidemiologists and the PH supervisor (1 time per week).

In general all epidemiologists make phone calls to their colleagues at least one time per week to discuss epidemiological issues but this statement didn't apply to the central level in the cases of chairman, administrator and ARIMAC because their job profile doesn't fix this type of relationship. In relation to PH supervisors 44.4% epidemiologists from central level didn't think it was necessary to phone their supervisors because they are in the same workplace but 44.8% epidemiologists from the same level didn't phone other epidemiologists in the same position as them. Table 11

Table 11. Communication between departments: phone calls frequency with colleagues to talk about epidemiological issues (%)

	Never	1 or less time /month	1 or several times /week	1 or several times /day	Many times /day	Don't know	No applicable
Chairman	18.4	0.4	45.4	20.8	1.3	0.4	13.3
Administrator	26.6	0.8	42.0	12.4	0.4	0.4	17.3
ARIMAC	19.9	0.4	43.9	19.1	0.9	0.2	15.6
Supervisor	8.8	1.9	62.7	11.5	2.1	1.3	11.6
Epidemiologists	14.8	2.2	57.4	10.3	2.4	1.7	11.3

The frequency of phone calls with other personnel to talk about epidemiological issues had the following pattern: 205 (52.0%) epidemiologists from all levels of care phoned their chairman at least one time per week (to 8.9% of epidemiologists from the central level this doesn't apply); 196(50.8%) epidemiologists also phoned one or more times per week the administrator in their workplace (except 85.2% from the central level) as well as ARIMAC (52.0%), immediate PH supervisor (70.9%) and other epidemiologists (64.7%). But also in the last case 36.4% epidemiologists from the central level phoned their colleagues several times per day.

Epidemiologists' opinion about accuracy of the current communication channels on a scale of 1 to 10, on average was graded as 6.25 (±2.52), only 19.9% epidemiologists from all levels of care gave "8" and 23.8% epidemiologists from national medical centers graded with 6. By level of care the highest average grade was given by central level epidemiologists (7.00±1.79), followed by delegation epidemiologists (6.90±2.22) and only 26.1% of them (delegation) graded with 8. The lowest grade was given by NMC epidemiologists (5.38±2.6); in this case only 19.8% gave 8 but 14.3% graded with five.

6.3.4. Work design

To explore the agreement of current epidemiologists' work design we asked them about variety, importance, feedback, organization and independence of their work in the IMSS. Questions 153, 159 and 162 explored variety at work 74.33% of the epidemiologists agreed or totally agreed that the current work design provides them variety; this observation is consistent through all care levels but it was more evident in the delegation level. Table 12

Independence was explored in questions 154, 158 and 161 63.36% epidemiologists from all levels of care agreed or totally agreed that their job design provides them independence to do their duties. Organization was assed in questions 155, 163 and 165. Here 61.26%

epidemiologists agreed or totally agreed that their work design allows them to organize appropriately their tasks, this statement was mainly agreed with DEL epidemiologists.

Table 12. Epidemiologists' Work design (%)

Questions/ Agreement (%)	Totally disagree	Disagree	More/ less disagree	No sure	More/ less agree	Agree	Totally agree
Variety							
153	0.6	3.6	3.2	0.6	10.5	49.0	32.3
159	2.1	5.6	5.1	1.7	18.2	45.2	21.8
162	0.6	3.6	2.1	2.4	16.7	48.4	25.9
Independence							
154	1.7	4.1	6.0	1.5	19.5	45.8	21.4
158	0.9	6.0	4.3	3.4	21.0	44.5	19.7
161	1.3	7.9	4.9	2.1	25.1	40.5	18.0
Organization							
155	2.6	7.9	5.4	4.1	19.3	43.9	16.9
163	1.3	5.8	4.5	2.8	21.6	45.0	18.6
165	1.5	7.5	6.2	2.6	22.9	41.5	17.6
Feedback							
156	2.8	8.4	6.6	5.1	22.5	44.1	10.5
160	1.3	5.6	5.6	3.9	21.2	45.2	17.1
164	0.6	5.6	3.9	3.2	18.6	47.3	20.6
Importance							
157	3.6	11.3	2.8	3.4	11.3	40.9	26.1
166	2.8	6.6	3.0	4.1	18.6	41.5	23.1

Questions 156, 160 and 164 addressed feedback, 61.7% epidemiologists agreed or totally agreed that current work design allows them get feedback; this opinion was consistent in all levels. Finally questions 157 and 166 studied work importance. Here 66.05% of the epidemiologists agreed or totally agreed that their work is important to the organization; but in question 157 we asked if they consider their job relatively important to the organization. NMC epidemiologists' opinions were divided between to "more or less agree" and "totally agree" and CL epidemiologists were more inclined to just agree.

In average the proportion of "not sure" answers was low (from 2.0% to 5.1%) and also the proportion of disagreements was low (from 3.6% to 11.4%). Considering all the variables explored, on average 44.21% epidemiologists from all levels of care agree with the current design of their work and this proportion increased to 65.34% when we considered the proportion of epidemiologists who totally agreed with their work design. DEL epidemiologists were who agreed more with their work design.

Almost 78% of the epidemiologists thought that their job provides variety, 63.4% said that they have independence to perform their work activities; 67.3% considered that they are well organized to achieve their duties and goals; 61.6% agreed that they receive feedback from their supervisors as well self-feedback; 65.8% thought that their work is important to the organization; 77% expressed that the work design allows them to develop different tasks at the same time as well as 59.1% agreed that it also allows them to complete their duties from the beginning to the end. Table 12

6.4. Research and Academic Activities

6.4.1. Research activities

Only 61 (13.1%) epidemiologists have published at least one scientific paper in medical journals; from them 66.6% were from the third level and the central level and 18.8% from delegations. From 61 epidemiologists 22 have one article published, 26 two papers and 13 more than three papers. On average they have published 1.98 (±1.10) articles and 42% had published two articles. Epidemiologists from the first level of care were the group with more publications (1-2 articles 95%) followed by epidemiologists from the second level (88.6%) and delegations (69.2%) Tables 13, 14

During the previous year of the 183 (39.2%) epidemiologists who did research activities, most were epidemiologists from delegations (36/52.2%) and national medical centers (10/47.6%). Currently 160 (34.3%) epidemiologists are developing research activities; from those 67(29.9%) were from PCU, but proportionally epidemiologists from national medical centers (47.6%) and delegations (47.8%) were the ones who are doing more research activities. Tables 13, 14

About research topics preferences in all levels of care 147(35.6%) epidemiologists were interested in infectious diseases, 53(12.8%) in cancer, 43(10.4%) in diabetes mellitus, 31(7.5%) epidemiology and 20(4.8%) in public health, 54 epidemiologists didn't have any topic of interest and the remainder had different kind of topics. Related to infectious diseases epidemiologists' preferences were focused in AIDS, tuberculosis, hepatitis and intra-hospital infections. Breast cancer and uterine cancer were their preferences in cancer topics. Table 13

From 467 subjects only 181 (38.8%) had participated in local research committees; 54.9% from PCU and 27.1% from GH.

On average during the previous year epidemiologists participated in 3.17 (±3.64) scientific meetings, 79.4% attended at least one meeting. From them 64.9% attended 1-5 meetings and 14.3% more than 5 meetings. From all the epidemiologists who participated in scientific meetings 181 were from PCU, 97 from GH and 57 from DEL. Related to papers submitted in these scientific meetings we found that they submitted 0.41 papers (±1.107). From 105 subjects who submitted a paper, 88 submitted one or two papers and 17 more than 3 papers. Epidemiologists from delegations were the ones with more papers submitted (40.5%) followed by epidemiologists of PCU (26.5%). Table 14

6.4.2. Academic activities

Most of the epidemiologists only read Spanish medical journals. As a first option, their preferences were: Mexican medical journals (326/69.8%), International Spanish journals (15/3.2%) and International English journals (68/14.6%); and 57 epidemiologists didn't read any medical journal. Also 431 epidemiologists only read Mexican medical journals and, 93 English international journals. The most frequent journals cited were: Salud Publica de Mexico, Revista IMSS, Gaceta Medica, Boletin de Epidemiologia, PAHO bulletin (Spanish version). Table 13

To be updated in public health and medicine topics, epidemiologists' main sources were medical journals (82.7%), Internet (66.8%) and medical books (61.9%). But most of them combined more than two options; the most common combinations were 55.0% (257) Internet and medical journals and 40.04%(187) Internet and medical books. Internet, library and scientific meetings were the main options cited by epidemiologists of the first and second levels. Table 13

The most frequent type of medical literature available in the workplace to support work activities was: manuals (446/95.5%), norms (435/93.1%) and books (310/66.4%). Medical literature was widely available in all levels of care; the Internet was more available in delegations and the central level.

Table 13. Research and academic activities

Concept	Number	Percent
Published articles		
Yes	61	13.1
No	406	86.9
Current research activities		
Yes	160	34.3
No	307	65.7
Research topic preferences		
Infectious diseases	147	31.5
Cancer	53	11.3
Diabetes mellitus	43	9.2
Epidemiology	31	6.6
Health systems	20	4.3
Women-child care	18	3.9
Chronic diseases	15	3.2
Immunizations	13	2.8
None	54	11.6
Others	73	15.6
Medical literature preferences		
National medical journals	326	69.8
International medical journals (Spanish)	15	3.2
International medical journals (English)	68	14.6
None	58	12.4
Information sources to be updated		
Internet	312	66.8
Library	244	52.2
Scientific meetings	147	31.5
Medical congresses	206	44.1
Medical journals	386	82.7
Books	289	61.9
Others	17	3.6
Attendance to scientific meetings during previous year		
Yes	371	79.4
No	96	20.6
Courses attended previous year		
1-5	303	81.67
6-10	48	12.94
11 +	20	5.39
Research papers submitted in scientific meetings		
0	266	71.69
1	69	18.59
2	15	4.04
3 +	17	4.58

Table 14. Research and academic activities by level of care

	Primary Care Units	General Hospitals	National Medical Centers	Delegations	Central Level
Published articles					
Yes	20 (8.9%)	12 (9.5%)	7 (33.3%)	13 (18.8%)	9 (33.3%)
No	204 (91.1%)	114 (90.5%)	14 (66.7%)	56 (81.2%)	18 (66.7%)
Number of articles published					
1	8 (40.0%)	7 (58.3%)	1 (14.3%)	1 (7.7%)	5 (55.6%)
2	9 (45.0%)	4 (33.3%)	3 (42.9%)	8 (61.5%)	2 (22.2%)
3+	3 (15.0%)	1 (8.3%)	3 (42.9%)	4 (30.8%)	2 (22.2%)
Current research activities					
Yes	67 (29.9%)	40 (31.7%)	10 (47.6%)	33 (47.8%)	10 (37.0%)
No	157 (70.1%)	86 (68.3%)	11 (52.4%)	36 (52.2%)	17 (63.0%)
Previous year research activities					
Yes	81 (36.2%)	45 (35.7%)	10 (47.6%)	36 (52.2%)	11 (40.7%)
No	143 (63.8%)	81 (64.3%)	11 (52.4%)	33 (47.8%)	16 (59.3%)
Scientific meetings previous year					
Yes	181 (80.8%)	97 (77.0%)	16 (76.2%)	57 (82.6%)	20 (74.1%)
No	43 (19.2%)	29 (23.0%)	5 (23.8%)	12 (17.4%)	7 (25.9%)
Courses attended previous year					
0	43 (19.2%)	29 (23.0%)	5 (23.8%)	12 (17.4%)	7 (25.9%)
1-5	146 (65.2%)	79 (62.7%)	12 (57.1%)	46 (66.7%)	20 (74.1%)
6-10	24 (10.7%)	14 (11.1%)	3 (14.3%)	7 (10.1%)	0
11+	11 (4.9%)	4 (3.2%)	1 (4.8%)	4 (5.8%)	0
Papers submitted in meetings					
0	187 (83.5%)	105 (83.3%)	14 (66.7%)	41 (59.4%)	15 (55.6%)
1-2	33 (14.7%)	16 (12.7%)	7 (33.3%)	21 (30.4%)	11 (40.7%)
3+	4 (1.8%)	5 (4.0%)	0	7 (10.1%)	1 (3.7%)
Participation in the research committee					
Yes	94 (42.0%)	49 (38.9%)	9 (42.9%)	23 (33.3%)	6 (22.2%)
No	130 (58.0%)	77 (61.1%)	12 (57.1%)	46 (66.7%)	21 (77.8%)
Students					
Yes	111 (49.6%)	59 (46.8%)	8 (38.1%)	15 (21.7%)	6 (22.2%)
No	113 (50.4%)	67 (53.2%)	13 (61.9%)	54 (78.3%)	21 (77.8%)
Type of students					
Medicine	58 (52.3%)	25 (42.4%)	2 (25.0%)	4 (26.7%)	1 (16.7%)
Nurses	31 (27.9%)	22 (37.3%)	1 (12.5%)	5 (33.3%)	1 (16.7%)
Epidemiology	7 (6.3%)	4 (6.8%)	3 (37.5%)	3 (20.0%)	3 (50.0%)
Others	15 (13.5%)	8 (13.6%)	2 (25.0%)	3 (20.0%)	1 (16.7%)

Currently 199 (42.6%) epidemiologists are doing teaching activities; from them 90(45.2%), have medical students, 60 (30.2%) nurses, 20(10.1%) epidemiologists and 29(14.6%) other kinds of students. Epidemiologists from the first and second levels of care (55.8% and 29.6% respectively) had more students than other levels, and also in these levels medical students and nurses were the most frequent type of students. Table 14

6.5. Epidemiological Systems

6.5.1. Epidemiological information System

On average epidemiologists completed 2.26 (±) reports per day, 8.47 (±) per week, 17.51 (±) monthly and 1.03 (±) reports with other frequency. In all levels of care the most frequent was to complete reports monthly (50.3%), mainly in the first two levels (50.2%, and 29.4% respectively); 58.8% epidemiologists didn't send daily reports and 33.6% sent between 1-5 reports everyday (mainly from PCU 29.2%). Between 1-5 reports was the most common frequency of weekly reports (250/55.7%), in particular in the three first levels of care. Between 1-5 monthly reports was the most frequent frequency (153/34.0%) mostly in the first three levels. Table 15

Almost 79% (367) of the epidemiologists said that they received feedback from their immediate PH supervisor; delegations' epidemiologists had the highest feedback rate (94.2%) and epidemiologists from central level the lowest (37.0%). The highest frequency of feedback was monthly (235/64.03%), from 235 epidemiologists, 50.2% were from primary care units. The information system that received more feedback was SUI-29 (159/34.0%) followed by SIVEIMSS (106/22.7%). In the first two levels of care SUI-29 was the most frequent system (44.2% and 35.7%), in contrast SIVEIMSS was the most frequent in delegations (73.9%) and to national medical centers was SIMO (42.9%). The delegation's PH coordinator was the person who most often provided feedback (282/60.4%) especially to first three levels of care; on the other hand, delegations' epidemiologists got more feedback from epidemiologists of the central level (78.3%). Table 15

Table 15. Feedback of the epidemiological information systems

	Number	Percent
Number of reports		
Daily	185	39.61
Weekly	348	74.52
Monthly	332	71.09
Other	74	15.84
No answer	18	3.85
Feedback		
Yes	363	77.7
No	104	22.3
Feedback program		
SIMO	79	16.9
SUI-29	160	34.3
SIVEIMSS	105	22.5
SISMOR	15	3.2
SISMET	36	7.7
Feedback frequency		
Daily	8	2.18
1-3/week	40	10.93
Weekly	68	18.58
Monthly	237	64.75
Don't know	13	3.55

Table 16. Epidemiologists' opinions about the accuracy of the epidemiological information programs (%)

System/Grade (%)	1	2	3	4	5	6	7	8	9	10	NA
SIMO	1.5	0.6	4.1	3.4	9.2	10.7	20.3	26.6	15.6	6.4	1.5
SUI-29	1.1	0.6	1.9	1.7	5.4	7.1	15.2	27.8	28.3	9.6	1.3
SIVEIMSS	1.9	0.4	2.1	1.9	4.3	7.3	10.7	23.8	25.5	10.1	12
SISMOR	4.7	2.1	3	3	6.6	8.8	8.1	18	17.6	6.2	21.8
INF. SEM.	0.9	0.2	0.4	1.9	4.1	4.1	10.7	22.3	38.3	15.4	1.7
SISMET	4.1	1.3	1.7	2.4	6.6	5.8	11.6	18	15.2	3	30.9
Overall	1.7	1.1	1.1	2.6	5.6	8.6	14.1	29.6	24.4	5.4	6.0

On a scale of 1 to 10 (not accurate to very accurate) epidemiologists graded the accuracy of the following programs as follows: SIMO 7.09 (±1.91) only 27% graded the system with 8 (mainly from PCU and GH) and 25% epidemiologists from delegations graded with 7 as well as 24% from the central level. The average grade of SUI-29 was 7.74 (±1.75), 29% epidemiologists gave 9 (75 from PCU) and 37% epidemiologists from the central level graded with 7. SIVEIMSS grade was 7.69 (±1.94) and 29% graded with 9 mainly from the first two levels of care. SISMOR got 6.60 (±2.77), only 22.1% epidemiologists graded SISMOR with 8, epidemiologists from general hospitals (22.9%) and delegations (34.8%) graded with 9, in contrast 26.9% epidemiologists from the central level gave 6. Communicable and non-communicable diseases report was graded with 8.21 (±1.59) 39% epidemiologists form all care levels graded with 9 and 37% epidemiologists form central level graded with 7. the average grade of SISMET was 6.56 (±2.69), only 24.6% graded with 8. The overall accuracy of the information system was 7.50 (±1.82), 34.4% epidemiologists from all levels of care graded the system with 8. Table 16

The most frequent epidemiologists' opinions among levels of care about missing information of some epidemiological reports were: 218 (46.7%) suggested modifications to the design and/or content of the Communicable and non-communicable diseases report. Forty-nine percent of epidemiologists didn't have any suggestion for the Mortality report and 112 (24.0%) commented on modifications to this report (40.2% from PCU and 24.6% from GH). 48.8% epidemiologists didn't provide any comment to the supplies and budget report and 142 (30.4%) epidemiologists suggested modifications to this report (25.4% from PCU and 52.2% from delegations). Besides these responses epidemiologists also expressed opinions related to organizational problems and data quality of these reports.

Table 17. The most frequent problems with epidemiological reports

	Collection (#/%)	Elaboration (#/%)	Sending (#/%)
None	46/9.9	84/18.0	154/33.0
Lack of supplies	30/6.4	103/22.1	22/4.7
Lack of human resources	25/5.4	50/10.7	32/6.9
Organizational problems	247/52.9	153/32.8	43/9.2
Deficient communication channels	7/1.5	4/0.9	209/44.8
Incomplete information	24/5.1	28/6.0	2/.04
Information bad quality	88/18.8	45/9.6	5/1.1

In the open questions section we invited epidemiologists to describe to us their problems in collecting, elaborating and sending epidemiological reports. Their replied that the most frequent problem in collecting data was organizational problems in the MCU (247/52.9%) followed by bad data quality (88/18.8%). The first problem was more important to epidemiologists from PCU (48.6%) and GH (29.1%) and the second problem was also more important to PCU (43.2%), GH (26.1%) and delegations (18.2%). In relation with the elaboration of reports again the most frequent to all levels of care was organizational problems (153/32.8%) in the workplace and secondly lack of material resources (103/22.1%). In both cases these were the most cited problem to PCU and GH. To send reports the most important problem to all care levels was referred to as deficient communications channels (209/44.8%) and the second organizational problems (43/9.2%). In contrast, 74.1% epidemiologists from the central level and 52.4% from national medical centers said that they don't have any problem to send their epidemiological reports. Table 17

6.5.2. Surveillance Epidemiological System

Epidemiologists' agreement about the current surveillance epidemiological system was as follows: they expressed in almost all the items that they just agreed with the current surveillance system; 152 (32.6%) epidemiologists agreed that the current notification channels are slow. This opinion was consistent through all levels of care. 44.1% (205) of epidemiologists agreed with the accuracy of notification forms, in particular epidemiologists from PCU (46.8%) and GH (33.7%) agreed with this statement and 17.3% epidemiologists from the central level disagreed. Table 18

Table 18. Epidemiologists' Opinion about the Surveillance epidemiological system: Notification forms and channels (%)

	Tot disagree	Disagree	M/L disagree	Not sure	M/L agree	Agree	Tot. agree
Channels	11.8	13.5	11.1	2.8	14.8	32.5	13.3
Forms	3	11.1	6.4	3.2	20.6	43.9	11.3
AIDS	2.1	6	6.4	2.1	18	51	14.1
Cholera	2.4	4.9	4.3	3	14.8	52.9	17.3
EFE's	1.5	5.6	5.8	2.4	19.1	49.7	15.6
Dengue	1.3	4.3	3.6	6	14.3	49.5	18.4
CaCu	3	5.8	6	3.6	16.3	45.8	18.4

The statement "the AIDS notification form is accurate" was agreed to by 51.1% (238) of epidemiologists from all levels of care. The same pattern was seen with the accuracy of the Cholera notification form where 53.1% (247) epidemiologists agreed with the accuracy of this form. All levels of care agreed that the exanthemata febrile diseases notification form is accurate (49.9%/232). It was agreed by 50.8% (231) of epidemiologists that the dengue notification form is accurate. Finally 46.3% (214) of epidemiologists from all levels of care agreed with the accuracy of the uterine cancer notification form. Table 18

6.5.3. Health Promotion Activities

From 467 epidemiologists 432 (92.5%) said that they are doing health promotion activities; 296 (63%) did theses activities daily, 12.6% (59) weekly, and 10.8% (47) monthly. Epidemiologists from primary care levels (54.8%) and general hospitals (31.6%) were the ones who more often performed this activity. Table 19

Table 19. Epidemiologists' health promotion activities

Concept	Number	Percent
Health promotion activities		
Yes	432	92.5
No	35	7.5
Topics		
Preventive care	68	15.74
Epidemiology	299	69.21
Health promotion	47	10.88
Other	18	4.17
Frequency		
Daily	25	6.23
Every week	151	37.65
Every month	140	34.91
Other	68	16.96
None	17	4.24

To all levels of care the most frequent health topic to provide health promotion was epidemiological surveillance topics (299/69.2%); in PCU, GH and NMC the second option was preventive medicine topics (17.6%, 15.3% and 27.8% respectively) and in delegations it was health promotions topics (17.2%).

The frequency of health promotion activities' solicitudes from the community was varied but most of the epidemiologists received weekly (151/37.8%) or monthly (140/35.1%) solicitudes, but to PCU epidemiologists was more frequent monthly solicitudes (39.8%).

In general all the epidemiologists used more than one resource to support health promotion activities. The most frequent sources were blackboards 65.3% (282) (from those 59.9% were epidemiologists from PCU and 28.4% from GH); slides (60.2%/260), mostly from PCU 50.0%; and videos (253/58.6%), in particular to epidemiologists from PCU (53.4%), GH (30.0%) and delegations (12.3%). Also 59.7% epidemiologists use other types of sources such as PowerPoint presentations and computer projectors.

6.5.4. Preventive Medicine Activities

In medical care units there are three basic preventive medicine activities: immunization, screening and control and treatment of diseases.

In the first three levels of care Poliomyelitis vaccine was the most commonly used vaccine, on average in each MCU every month were applied 1419.02 (±420) doses, followed by triple viral vaccine (576.45 ±190) and the least frequent was neomococcus vaccine (291.52 ±80). Forty-seven percent MCU applied between 101-500 poliomyelitis vaccines, but in 76.2% PCU this rank was from 101-1000 doses. 52.4% applied between 101-500 doses of triple viral vaccine, it was more common in PCU (75.1%). 1-100 doses of Neunococcus vaccine (55.5%) were applied in each MCU in the first three levels.

From 467 epidemiologists 321 (68.7%) said that they know the immunization coverage in their MCU, in particular epidemiologists from PCU, GH and delegations. 52.5% used PROVAC (Vaccines Program Registry) as their source to monitor coverage, 19.1% used their own registries and 10.5% delegation registries, but 101 epidemiologists used simultaneously two sources. PROVAC registries were widely used in PCU (53.6%), GH (27.4%) and delegations (19.3%), on the other hand, their own registries were more used in PCU (62.9%) and GH (31.5%). Table 20

Four hundred-ten of 467 epidemiologists used internal controls to monitor immunization activities, 64.2% epidemiologists used nominal registries and 12.2% quantitative registries. 270 epidemiologists had only one internal control and 117 used two internal controls. 34.9% epidemiologists from PCU had nominal registries and 7.9% quantitative registries.

To control immunization supplies the most frequent source used was IMSS registries (46.5%) but by level of care, 112 (60.2%) PCU and NMC (44.8%) epidemiologists use more their own nominal registries. Seventy-six epidemiologists used two internal controls.

Three hundred fifty-nine epidemiologists said that PROVAC data was entered into the database by PH personnel in their workplace, 171(36.6%) MCU performed this activity by hand and 168(36.0%) using computers. To enter the data by hand was the most common option to PCU (66.1%) and GH (31.0%); in contrast 87% of delegations entered data using computers.

To all levels of care, every month was the most frequent time to send PROVAC data to the immediately PH supervisor (241/51.6%), but mainly by PCU (48.7%). From a scale of 1 to 10 the average accuracy given to the PROVAC census to support work activities according with the epidemiologists' opinions was 7.91 (±1.87), where 61.0% epidemiologists graded it with 8-9.

Table 20. Preventive medicine activities

Concept	Number	Percent
Immunizations		
Immunization coverage		
Yes	321	84.03
no	61	15.97
Coverage monitory:		
Own registries	89	22.30
PROVAC registry	49	12.28
Delegation registries	244	61.15
None	8	2.0
Other	9	2.25
Immunization activities control:		
Nominal registries	300	73.17
Quantitative registries	57	13.9
IMSS registries	43	10.48
None	8	1.95
Other	2	0.49
Internal supplies control:		
Nominal registries	186	44.82
IMSS registries	217	52.29
None	10	2.41
Other	2	0.48
PROVAC Data entering:		
By hand	171	47.63
Computer	168	46.79
Other	20	5.57
PROVAC sending frequency:		
Daily	14	5.04
Weekly	11	3.96
Monthly	241	86.69
Other	12	4.32
Screening		
Screening coverage:		
Own registries	241	57.93
Delegation registries	133	31.97
National registries	18	4.33
None	9	2.16
Other	15	3.61
Internal supplies control:		
Nominal registries	189	45.65
IMSS registries	210	50.72
None	9	2.17
Other	6	1.45
Control and treatment diseases		
Registries (yes/no):		
Tuberculosis	386/12	96.98/3.01
Sexual transmitted diseases	341/56	85.89/14.11
Malaria	164/233	41.31/58.69
Rheumatic fever	154/243	38.79/61.21

According to epidemiologists' answers the three most frequent screenings in the MCU were diabetes mellitus (340/72.8%), hypertension (257/55.0%) and uterine cancer (217/46.5%). By level of care the most frequent to primary care units were diabetes mellitus, hypertension and uterine cancer, in general hospitals were diabetes mellitus, hypertension and congenital hypothyroidism and, in national medical centers were hepatitis B, HIV and congenital hypothyroidism.

In the first three levels of care the monthly average of diabetes mellitus screenings was 1621.82 ±3744.9, hypertension 1707.72 ±3788.05, uterine cancer 835.48 ±2064.3, breast cancer 848.24 ±2001.46, hepatitis B 191.87 ±645.23, HIV 183.03 ±551.04 and congenital hypothyroidism 181.81 ±435.09.

Every month, 36.4% MCU applied more than 1000 diabetes mellitus screenings, mainly in PCU (67.5%) and GH (43.7%). Almost 42% MCU applied each month more than 1000 hypertension tests (71.0% n PCU). 54.5% MCU did between 1-100 congenital hypothyroidism screenings tests, mainly in PCU (84.5%), but in 82.6% GH were made101-500 screenings monthly.

Four hundred eighteen epidemiologists of 467 used some source to monitor screening coverage in their workplaces; from them 103 used more than one source simultaneously. The most common sources were: their own registries (241/51.6%), delegation registries (133/28.5%). Own registries were the most frequent in PCU (59.3%) and GH (34.9%), delegation registry in delegations (35.3%), and the central level used more national registries (33.3%). Table 20

Four hundred fourteen epidemiologists used internal controls to registry screening supplies in their services, from them 84 used simultaneously two internal controls (nominal/IMSS registries). Screenings supplies were monitored mainly using IMSS registries forms (45.0%) and nominal registries (40.5%). PCU (113/53.8%) and delegations epidemiologists (42/20.0%) used more IMSS forms; GH used more their own registries (62/49.2%)

In relation to treatment and control of diseases registration, 386 (82.7%) epidemiologists from 467 had tuberculosis registry, and 341 (73.0%) sexual transmitted diseases (STD) registry. In contrast 49.9% epidemiologists didn't have Malaria registry and 52.0% rheumatic fever registry. Tuberculosis and STD registry were more common in PCU 56.7% and 58.4% respectively. Table 20

On average, in all care levels there were 9.31 ±14.46 Tuberculosis patients in control, 15.04 ±89.5 with STD, 0.168 ±0.97 with malaria and 0.74 ±2.42 with rheumatic fever. The most common situation was to have between 1-5 tuberculosis patients (57.9%) in the first three levels of care and between 1-5 patients with STD (54.8%) in particular in the two first levels of care. It was not most common to have patients with malaria and rheumatic fever in control.

6.6. Desirability of computer applications in Public Health

6.6.1. Computer applications in medicine and public health.

Patient care. Applications related with patient care such as electronic medical records and monitoring systems in general were considered as "convenient" to "very convenient" by more than 78.62% of the study population; this observation was consistent through all levels of care. Table 21

Medical decision-making. These applications (tools related to interactive databases) were ranked as “convenient” to “very convenient” by 71.5% of the study population; in particular they supported more data interchange between MCU (84.4%). Table 21

Table 21. Desirability of computer applications in public health: Computer applications

Question/ Agreement (%)	Very inconvenient (%)	Inconvenient (%)	Neutral (%)	Convenient (%)	Very convenient (%)
Patient care					
60	1.3	0.2	1.1	22.5	74.9
61	1.1	0.6	1.5	19.1	77.7
62	1.1	0.6	1.7	17.6	79.0
63	1.3	1.3	4.7	29.1	63.6
64	1.3	1.3	2.1	21.4	73.9
65	1.1	0.0	1.5	15.6	81.8
66	1.1	0.0	0.6	12.8	85.4
Decision-making					
67	1.3	0.6	4.3	27.2	66.6
68	0.9	0.9	2.4	28.5	67.5
69	0.9	0.9	2.4	28.5	67.5
70	1.1	0.2	0.6	13.7	84.4
Physician substitute					
71	1.7	3.6	10.3	33.0	51.4
72	10.1	22.5	16.5	22.7	28.3
73	28.7	26.8	17.1	12.6	14.8

Physician substitute. This topic generated some controversy in one item; they didn’t clearly agree or disagree with the idea that other medical personnel and/or patients assume some of the traditional epidemiologists’ roles. Other applications such as continuous long distant education were welcomed (51.4%). Only 28.3% epidemiologists considered it “very convenient” to support more active patients’ role in their health using computer technology. Also 28.7% of epidemiologists thought as “very inconvenient” the possibility that computer system support paramedical personnel in providing diagnosis and treatment recommendations to patients; this position was more evident in PCU (52.0%) and central level (33.3%), in contrast epidemiologists from delegations had divided opinions about this issue (between very inconvenient to neutral). Table 21

In general epidemiologists strongly supported computer applications related to patient care and decision-making tools but they didn't support physician substitute applications.

6.6.2. Consequences in medicine related to the use of computers

Cost and quality care. In general there was a full agreement among epidemiologists (45.5%) that the use of computer technology would help to reduce medical care cost and increase the quality care in their medical care units. Table 22

Epidemiologists' autonomy. 49.7% of epidemiologists from all care levels totally agreed with the statement to have more autonomy to do epidemiological activities with the help of computerized registries, but 59.36% of central level epidemiologists just agreed with this idea. Forty-five epidemiologists agreed to leave monitory activities to computers systems in order to have more organized data to develop more accurate decision-making processes. Opinions were divided about privacy issues; 31.3% epidemiologists didn't think that computer systems can threaten professional privacy; in contrast 25% PCU epidemiologists and 29.6% central level epidemiologists agreed that privacy would be affected by the use of computers, but the trend was more inclined to disagree (43.5%) with this statement. On the other hand, 40.0% of epidemiologists disagreed that the increased use of computer technology would generate legal or ethical problems. Table 22

Table 22. Desirability of computer applications: Consequences in medicine related to the use of computers

Question/%	Totally disagree (%)	Disagree (%)	No sure (%)	Agree (%)	Totally agree (%)
Cost and quality care					
74	1.9	6.4	15.6	46.7	29.3
75	4.1	15.8	16.5	37.7	25.9
76	0.6	8.1	4.7	40.7	51.8
77	1.7	3.4	13.7	42.8	33.6
78	1.3	4.9	6.9	47.5	40.9
79	1.9	2.8	6.6	40.9	45.6
Autonomy					
80	0.9	2.8	5.1	41.5	49.7
81	1.3	4.1	5.6	45.8	43.3
82	12.2	31.3	22.1	23.1	11.3
83	13.1	40.0	24.2	15.8	6.9
Physicians role					
84	40.0	40.5	7.1	9.2	3.2
85	31.5	48.6	12.0	6.4	1.5
86	32.3	47.1	10.1	8.1	2.4
87	34.7	49.3	8.8	5.6	1.7
88	27.6	46.0	13.7	9.0	3.6
89	37.9	46.9	8.1	5.4	1.7
90	39.0	48.6	6.9	4.5	1.1
91	30.6	51.2	9.0	7.3	1.9
92	26.3	48.0	11.6	12.0	2.1
Manpower					
93	12.4	36.0	16.9	26.6	2.6
94	43.3	42.2	6.2	5.8	19.1
Organization					
95	7.3	19.3	7.5	46.9	19.1
96	8.6	26.3	21.8	32.1	11.1
97	13.9	35.1	22.1	21.6	7.3
98	8.8	23.6	23.6	36.6	7.5
99	7.7	19.9	10.5	43.5	18.4
100	9.2	19.1	14.6	37.7	19.5

Epidemiologists of all levels of care considered that computer technology would increase the medical care quality and decrease costs but in issues related with autonomy they were more cautious, especially in those related to privacy and legal actions against them.

Physician's role. Almost 81% of epidemiologists thought that the use of computer technology as a tool to perform their job would not decrease or deteriorate their role and image with their patients. 40.5% epidemiologists disagreed that it would be difficult to learn how to use a computer system, 48.6% epidemiologists from all care levels disagreed that computer systems would generate dependency on medical literature instead of epidemiologists' judgment. 47.1% thought that computer applications don't depersonalize their practice; 49.3% didn't agree that computers would have a negative impact on epidemiologists with their patients; also 46.0% disagreed that computers systems are time consuming and that they would make epidemiologists' time less efficient. 46.9% subjects didn't think that epidemiologists' image as decision-makers would be threatened if computer systems become diagnosis tools; on the other hand, they disagreed that patients' epidemiologists' image would be damaged if patients see them using computers at work and 51.2% didn't agree that patients' satisfaction would decrease patient care perception. 48% epidemiologists from all levels of care disagreed that qualitative information would be not important with the use of computer applications. Table 22

Manpower. 85.5% epidemiologists didn't expect that their job positions would be compromised with the arrival of computer applications. In the other hand, almost 48.4% thought that computer technology would reduce the need of paramedical personnel and 34.7% expressed that this kind of personnel would not be needed anymore. Table 22

Organization. Sixty-six percent opined that computer technology is allied to health care organization, 32.1% agreed that computer technology would change the current trend of medical sciences toward more psychological and social aspects of health care; in contrast 26.3% expressed opinions against this possibility. 49% agreed or totally agreed that computer applications wouldn't decrease the current dependency on others specialists but also 22.1% of epidemiologists weren't sure about this statement and 21.6% agreed with this possibility. 36.6%

expressed agreement about receiving advice from computer applications in decision-making related to treatments and 23.6% were in disagreement (mainly in PCU and GH); on the other hand 23.6% weren't sure about this statement (PCU and DEL). 61.9% supported the idea that health care decentralization would be promoted with the arrival of computer technology and 57.2% agreed or totally agreed to give limited access to diagnosis and treatment software to those physicians specify trained to used it. Table 22

6.6.3. Computer's applications and tools

Through all levels of care epidemiologists' opinions were consistent in thinking as very convenient to the public health field the use of text processors (58.0%), statistical software (74.5%), epidemiological atlas (79.7%), continuous education programs (74.3%), relational databases (73.0%) and online services such as notifications (66.8% and 73.2%), data sending (71.7%)/data reception (71.1%), online consultations (80.9%), multilevel communication in real time (61.9% and 68.1%, feedback systems (73.7%), and Internet access (77.9%). Only one item related to automated patient phone calls system received 58.0% of positive opinions. Table 23

In particular, epidemiologists showed more interest in computer applications like Internet access, epidemiological atlas, online documents consultation and long distance medical education.

Table 23. Desirability of computer applications: use of computer tools and applications in public health services

	Very inconvenient (%)	Inconvenient (%)	Neutral (%)	Convenient (%)	Very convenient (%)
Text processors, data analysis					
101	1.5	0.0	2.1	38.3	58.0
102	0.9	0.2	0.9	23.6	74.5
103	0.9	0.0	0.0	26.1	73.0
Interactive databases management					
104	0.9	0.0	1.3	31.	66.8
105	0.9	0.0	0.2	25.7	73.2
106	0.9	0.4	0.4	26.6	71.7
Online applications					
107	1.1	2.8	6.2	31.9	58.0
108	0.9	0.9	2.8	33.6	61.9
109	0.9	0.4	0.6	30.0	68.1
110	1.1	0.2	0.9	26.8	71.1
111	0.9	0.4	0.6	24.4	73.7
112	1.1	0.0	0.9	20.1	77.9
113	1.1	0.0	0.4	18.8	79.7
114	1.1	0.0	0.9	17.1	80.9
115	1.1	0.2	1.5	22.9	74.3

Table 24. The most suitable health personnel to enter data in automated information systems

	Preventive medicine reports	Epidemiological notifications reports	Mortality and morbidity reports
Epidemiologist	138/29.6%	323/69.2%	271/58.0%
PH nurse	329/70.4%	150/32.1%	104/22.3%
General nurse	67/14.3%	22/4.7%	17/3.6%
Auxiliary nurse	81/17.3%	22/4.7%	15/3.2%
Auxiliary office assistant	109/23.3%	68/14.6%	68/14.6%
ARIMAC personnel	154/33.0%	208/44.5%	282/60.4%
Other	67/14.3%	48/10.3%	57/12.2%

6.6.4. Automated epidemiological information system

We invited epidemiologists to image that if they had the chance to have automated information software in their departments then, who would be the most appropriate personnel to enter data into the main epidemiological information systems. Our results showed that there was strong agreement among all epidemiologists about who are the most suitable personnel to enter data of preventive medicine into a computer system: 70.4% of the epidemiologists thought that the public health nurse is the best option but also they considered ARIMAC (Informatics department) personnel (33.0%) for participation in this task. Table 24

About entering data of epidemiological surveillance activities into computer systems epidemiologists said that this task should be done mainly by them (69.2%) and as a second option, by ARIMAC personnel (44.5%). Table 24

Epidemiologists' opinions about who are the most appropriate personnel to enter data of mortality and morbidity in a computer system showed a shared responsibility between epidemiologists (58.0%) and ARIMAC personnel (60.4%). Table 24

In the three cases epidemiologists saw ARIMAC personnel as allied to support these kind of activities, but also they thought that preventive medicine and epidemiological surveillance data entering are exclusive activities to be performed by PH nurses and epidemiologists.

Epidemiologists' opinions about automated information systems in their workplaces in a scale from 1 to 10 were as follow: the overall grade's epidemiologists related with the statement "the computer system would have an excellent accuracy" was 8.70 (±1.3), the highest average grade was given in GH (8.87±1.14) and NMC (8.81±1.25) but 30.4% epidemiologists graded with 10 (mainly from PCU and GH). Table 25

"The chance that epidemiologists will use a computer system" got 9.35 (±1.06), the highest grades were given by epidemiologists from NMC (9.67±0.58), PCU (9.37±1.10), and GH (9.32±1.16); 60.4% (282) epidemiologists graded with 10 and 44.4% epidemiologists from the central level graded with 9. Table 25

Table 25. Epidemiologists' opinions about automated information systems in their workplaces (from scale 1-10)

	Primary care units	General hospitals	National medical centers	Delegation	Central level	Total
"The computer system would have an excellent accuracy"	8.64±1.45	8.87±1.14	8.81±1.25	8.71±1.14	8.33±0.96	8.7±1.3
"The chance that epidemiologists will use a computer system"	9.37±1.10	9.32±1.16	9.67±0.58	9.35±0.80	9.11±1.12	9.35±1.06
"Other personnel in their department would use the computer system"	8.30±2.06	8.08±2.58	9.38±0.67	9.09±0.99	8.93±0.92	8.44±2.05
"The system will be a success"	9.10±1.18	9.10±1.06	9.33±0.73	9.22±0.85	8.56±1.55	9.10±1.12

In regard to "other personnel in their department would use the computer system" the average grade was 8.44 (±2.05). The highest grades were given in NMC (9.38±0.67) and delegations (9.09±0.99); 38.3% epidemiologists from all levels of care graded with 10 this statement and 24.4% with 9, only in the central levels the opinions were divided between 8 (33.3%) and 10 (33.3%). Table 25

The statement "the system will be a success" was graded 9.10 (±1.12), the highest average grade was given by epidemiologists from NMC (9.33±0.73) and delegations (9.22±0.85) and the lowest by the central level (8.56±1.55); 45.2% epidemiologists gave 10 and epidemiologists from the central level (48.1%) graded with 9. Table 25

6.7. Influence of information technology access on epidemiologists' opinions

Study variables such as gender, age, and time working in the Mexican Institute of Social Security didn't show associations, trends or differences between groups that were statistically significant than to tell us that those epidemiologists who have more access to information technology have better opinion about the epidemiological information system, as well as about the desirability of computer applications in public health. Table 26

There were no differences in accessing information technology at work between male and females group. There were small associations that favor women over men related to Internet tools but this association was not statically significant (Table 27). There were not differences among age groups and their access to information technology. Table 28

Table 26. Associations between computer technology access and epidemiologists' age groups

	Age 30-39	group 40-49	(years) 50 +	OR	M	P value
Computer						
Yes	31	170	81	1.21	.49	NS
No	24	107	54	1.16		
E-mail						
Yes	14	63	27	.86	.76	NS
No	41	214	108	.73		
Internet						
Yes	19	108	38	1,21	4.69	.10
No	36	169	97	.74		

* OR=Odds ratio, M=Mean

Job position showed that there were more epidemiologists in normative levels with computer access at work than epidemiologists in primary care units (x2=60.71, p=0.00). There were not differences among epidemiologists' job positions and their access to e-mail. There were more epidemiologists in normative levels with Internet access at work than epidemiologists in primary care units (x2=144.85, p=0.00). There were more epidemiologists in normative levels with Internet tools (Internet and e-mail) access at work than epidemiologists in primary care units (x2=128.92, p=0.00). There were more epidemiologists in normative levels with information technology (computer, Internet and e-mail) access at work than epidemiologists in primary care units (x2=169.25, p=0.00). Table 29

There were not a trend and association between job position time and epidemiologists who have computers at work. Epidemiologists with less time working in their current position had more e-mail access in their workplace than those who don't (X^2= 16.77, p< .01). Epidemiologists with 1-5 years in their current position job had more access to Internet than those epidemiologists with more time (X^2= 11.79, p< .025). Table 30

Table 27. Epidemiologists' gender and information technology access at workplace

	Gender									
	Female			Male						
	#	%	S.R.	#	%	S.R.	OR	C.I.	X 2	P-value
Computer										
Yes	94	58.0	-.4	188	61.6	.3	.86	.58-1.27	.58	.45
No	68	42.0	.5	117	38.4	-.3				
Total	162	100		305	100					
E-mail										
Yes	40	24.7	.7	64	21.0	-.5	1.23	.79-1.94	.84	.36
No	122	75.3	-.3	241	79.0	.3				
Total	162	100		305	100					
Internet										
Yes	63	38.9	.8	102	33.4	-.6	1.27	.85-1.88	1.37	.24
No	99	61.1	-.6	203	66.6	.4				
Total	162	100		305	100					
Internet tools										
I or E	65	40.1	.6	109	35.7	-.4	1.2	.81-1.78	.87	.35
I and E	97	59.9	-.5	196	64.3	.3				
Total	162	100		305	100					
Information technology										
None	68	42.0	.5	117	38.4	-.3			.82	.84
C	48	29.6	-.4	98	32.1	.3	.94			
C & I	18	11.1	-.4	39	12.8	.3	.79			
C, I & E	28	17.3	.1	51	10.9	-.1	.84			
Total	162	100		305	100					

S.R.: Standard Residual, OR: Odds Ratio, C.I.: 95% Confidence interval, X2: Chi-square
C: Computer, E: e-mail, I: Internet

Epidemiologists that have been working between 1.01-5.0 years in their current job position had more e-mail, Internet, Internet tools and information technology access at workplace than epidemiologists that have been working less than one year or more than 5 years in their current position. Table 31

There were no differences between the time that epidemiologists have been working in the IMSS and their access to information technology at work. Table 32

Table 28. Information technology access at workplace by epidemiologists' age groups

	Age group								
	30-39			40-49			50 +		
	#	%	S.R.	#	%	S.R.	#	%	S.R.
Computer *									
Yes	31	56.4	-.4	170	61.4	.2	81	60.0	-.1
No	24	43.6	.5	107	38.6	-.3	54	40.0	.1
Total	55	100		277	100		135	100	
E-mail **									
Yes	14	25.5	.5	63	22.7	.2	27	20.0	-.6
No	41	74.5	-.3	214	77.3	-.1	108	80.0	.3
Total	55	100		277	100		135	100	
Internet ***									
Yes	19	34.5	-.1	108	39.0	1.0	38	28.1	-1.4
No	36	65.5	.1	169	61.0	-.8	97	71.9	1.0
Total	55	100		277	100		135	100	
Internet tools &									
I or E	21	38.2	.1	111	40.1	.8	42	31.1	-1.2
I and E	34	61.8	-.1	166	59.9	-.6	93	68.9	.9
Total	55	100		277	100		135	100	
Information technology &&									
None	24	43.6	.5	107	38.6	-.3	54	40.0	.1
Computer	15	27.3	-.5	82	29.6	-.5	49	36.3	1.0
C and I	7	12.7	.1	37	13.4	.5	13	9.6	-.9
C, I and E	9	16.4	-.1	51	18.4	.6	19	14.1	-.8
Total	55	100		277	100		135	100	

S.R.: Standard Residual, OR: Odds Ratio, C.I.: 95% Confidence interval, X2: Chi-square
C: Computer, E: e-mail, I: Internet
*=X^2 .49, p= .78, **=X^2 .76, p= .68, ***=X^2 4.69, p= .09
&= X^2 3.14, p= .21, &&= X^2 3.98, p= .68

Table 29. Information technology access at workplace by Epidemiologists' job position

	Job position								
	Primary care units			**Hospitals**			**Normative**		
	#	**%**	**S.R.**	**#**	**%**	**S.R.**	**#**	**%**	**S.R.**
Computer *									
Yes	98	43.8	-3.2	99	67.3	1.1	85	88.5	3.6
No	126	56.3	4.0	48	32.7	-1.3	11	11.5	-4.4
Total	224	100		147	100		96	100	
E-mail **									
Yes	10	18.9	-.5	18	26.1	.7	41	20.9	-.4
No	43	81.1	.3	51	73.9	-.4	155	79.1	.2
Total	224	100		147	100		96	100	
Internet ***									
Yes	28	12.5	-5.7	58	39.5	.8	79	82.3	7.7
No	196	87.5	4.2	89	60.5	-.6	17	17.7	-5.7
Total	224	100		147	100		96	100	
Internet tools [&]									
I or E	35	15.6	-5.3	60	40.8	.7	79	82.3	7.2
I and E	189	84.4	4.1	87	59.2	-.5	17	17.7	-5.6
Total	224	100		147	100		96	100	
Information technology [&&]									
None	126	56.3	4.0	48	32.7	-1.3	11	11.5	-4.4
Computer	78	34.8	1.0	53	36.1	1.0	15	15.6	-2.7
C and I	15	6.7	-2.4	25	17.0	1.7	17	17.7	1.5
C, I and E	5	2.2	-5.3	21	14.3	-.8	53	55.2	9.1
Total	224	100		147	100		96	100	

S.R.: Standard Residual, OR: Odds Ratio, C.I.: 95% Confidence interval, X2: Chi-square
C: Computer, E: e-mail, I: Internet
*=X^2 60.71, p=.000, **=X^2 1.37, p=.84, ***=X^2 144.85, p=.000
&= X^2 128.92, p=.000, &&= X^2 169.25, p=.000

Table 30. Associations between computer technology access and epidemiologists' time job position

	Job position time (years)							
	.01-1.0	1.01-5.0	5.01-10.0	10.01-15.0	15.01 +	OR	M	P value
Computer								
Yes	33	85	66	66	32	1.32	4.52	NS
No	21	41	45	55	23	0.93		
						0.76		
						0.88		
E-mail								
Yes	8	41	29	20	6	2.77	16.77	< .01
No	46	85	82	101	49	2.03		
						1.14		
						0.70		
Internet								
Yes	21	58	38	34	14	1.34	11.79	.025
No	33	68	73	87	41	0.82		
						0.61		
						0.54		

OR=Odds ratio, M=Mean

Table 31. Epidemiologists' time in the current job position and information technology access at workplace

	Time job position (years)														
	.01-1.0			1.01-5.0			5.01-10.0			10.01-15.0			15.01 +		
	#	%	S.R.	#	%	S.R.	#	%	S.R.	#	%	S.R.	#	%	S.R.
Computer *															
Yes	33	61.1	.1	85	67.5	1.0	66	59.5	-.1	66	54.5	-.8	32	58.2	-.2
No	21	38.9	-.1	41	32.5	-1.3	45	40.5	.2	55	45.5	1.0	23	41.8	.3
Total	54	100		126	100		111	100		121	100		55	100	
E-mail **															
Yes	8	14.8	-1.2	41	32.5	2.4	29	26.1	.9	20	16.5	-1.3	6	10.9	-1.8
No	46	85.2	.6	85	67.5	-1.3	82	73.9	-.5	101	83.5	.7	49	89.1	1.0
Total	54	100		126	100		111	100		121	100		55	100	
Internet ***															
Yes	21	38.9	.4	58	46.0	2.0	38	34.2	-.2	34	28.1	-1.3	14	25.5	-1.2
No	33	61.1	-.3	68	54.0	-1.5	73	65.8	.1	87	71.9	1.0	41	74.5	.9
Total	54	100		126	100		111	100		121	100		55	100	
Internet tools [&]															
I or E	22	40.7	.4	60	47.6	1.9	40	36.0	-.2	38	31.4	-1.1	14	25.5	-1.4
I and E	32	59.3	-.3	66	52.4	-1.5	71	64.0	.2	83	68.6	.8	41	74.5	1.1
Total	54	100		126	100		111	100		121	100		55	100	

Table 31. (Continued)

	Time job position (years)														
	.01-1.0			**1.01-5.0**			**5.01-10.0**			**10.01-15.0**			**15.01 +**		
	#	**%**	**S.R.**	**#**	**%**	**S.R.**	**#**	**%**	**S.R.**	**#**	**%**	**S.R.**	**#**	**%**	**S.R.**
Information technology &&															
None	21	38.9	-.1	41	32.5	-1.3	45	40.5	.2	55	45.5	1.0	23	41.8	.3
Computer	16	29.6	-.2	35	27.8	-.7	35	31.5	.1	37	30.6	-.1	23	41.8	1.4
C and I	12	22.2	2.1	15	11.9	-.1	11	9.9	-.7	15	12.4	.1	4	7.3	-1.0
C, I and E	5	9.3	-1.4	35	27.8	3.0	20	18.0	.3	14	11.6	-1.4	5	9.1	-1.4
Total	54	100		126	100		111	100		121	100		55	100	

S.R.= Standard Residual
C= Computer. E= e-mail. I= Internet
*=X^2 4.52, p=.34; **=X^2 16.77, p=.002; ***=X^2 11.79, p=.02
&= X^2 11.19, p=.025; &&= X^2 26.05, p=.011

Table 32. Epidemiologists' time working in the Mexican Institute of Social Security and information technology access at workplace

	Time IMSS job (years)														
	.01-5.0			5.01-10.0			10.01-15.0			15.01-20.0			20.01 +		
	#	%	S.R.	#	%	S.R.	#	%	S.R.	#	%	S.R.	#	%	S.R.
Computer *															
Yes	30	56.6	-.4	35	50.7	-1.0	121	61.7	.2	66	68.0	1.0	30	57.7	-.2
No	23	43.4	.4	34	49.3	1.3	75	38.3	-.3	31	32.0	-1.2	22	42.3	.3
Total	53	100		69	100		196	100		97	100		52	100	
E-mail **															
Yes	10	18.9	-.5	18	26.1	.7	41	20.9	-.4	22	22.7	.1	13	25.0	.4
No	43	81.1	.3	51	73.9	-.4	155	79.1	.2	75	77.3	.0	39	75.0	-.2
Total	53	100		69	100		196	100		97	100		52	100	
Internet ***															
Yes	16	30.2	-.6	25	36.2	.1	66	33.7	-.4	38	39.2	.6	20	38.5	.4
No	37	69.8	.5	44	63.8	-.1	130	66.3	.3	59	60.8	-.5	32	61.5	-.3
Total	53	100		69	100		196	100		97	100		52	100	
Internet tools [&]															
I or E	17	32.1	-.6	27	39.1	.3	70	35.7	-.4	39	40.2	.5	21	40.4	.4
I and E	36	67.9	.5	42	60.9	-.2	126	64.3	.3	58	59.8	-.4	31	59.6	-.3
Total	53	100		69	100		196	100		97	100		52	100	

Table 32. (Continued)

	Time IMSS job (years)														
	.01-5.0			5.01-10.0			10.01-15.0			15.01-20.0			20.01 +		
	#	%	S.R.	#	%	S.R.	#	%	S.R.	#	%	S.R.	#	%	S.R.
Information technology [&&]															
None	23	43.4	.4	34	49.3	1.3	75	38.3	-.3	31	32.0	-1.2	22	42.3	.3
Computer	15	28.3	-.4	18	26.1	-.8	64	32.7	.3	34	35.1	.7	15	28.8	-.3
C and I	8	15.1	.6	6	8.7	-.8	23	11.7	-.2	15	15.5	.9	5	9.6	-.5
C, I and E	7	13.2	-.7	11	15.9	-.2	34	17.3	.1	17	17.5	.1	10	19.2	.4
Total	53	100		69	100		196	100		97	100		52	100	

S.R.= Standard Residual
C= Computer. E= e-mail. I= Internet
*=X^2 5.69, p=.22; **=X^2 1.37, p=.85; ***=X^2 1.72, p=.79
&= X^2 1.49, p=.83; &&= X^2 7.74, p=.80

6.7.1. Work environment

In order to find possible associations between information technology access and work activities and work functions we selected those variables that are more related with information technology such as filling out forms, data processing, data analysis, planning and evaluation, research and supervision.

Epidemiologists who have computers at work tended to spend less time filling out forms than those who don't (X^2= 11.83, p< .01); related to e-mail access there was a significant association (X^2= 15.06, p= < .01) and Internet access was also statistically significant (X^2= 29.80, p < .001). Table 33

Epidemiologists who have computers tended to use a bigger proportion of their time doing data processing than those who don't (X^2= 41.12 p= .001); in relation with e-mail access there was no association and with Internet the trend was significant (X^2= 28.77, p< .001). Table 33

The proportion of time spent doing data analysis tends to increase more in epidemiologists who have computers at work in comparison with those who don't but the association was not significant (X^2= 2.17, p= NS). The same situation was found with e-mail (X^2= 1.41, p=NS) and Internet access and was not significant (X^2= 4.32, p= NS). Table 34

There was no trend between the proportion of time that epidemiologists invested in doing planning and evaluation and having or not having computer in workplace. Epidemiologists with e-mail access at work also tended to invest more time planning and evaluating than those who don't (X^2= 11.18, p< .01) as well as those who have Internet access (X^2= 15.44, p< .001). Table 34

Table 33. Work activities during the previous day and computer technology (CT) access

CT/ hrs	0	.01-59	1.00-1.59	2.00 +	OR	X^2	P value
		Time spent filling forms					
Computer							
Yes	52	65	108	57	.95	11.83	< .01
No	25	33	64	63	.81		
					.43		
E-mail							
Yes	30	19	37	21	.38	15.06	.01
No	47	79	151	99	.9		
					.5		
Internet							
Yes	45	41	51	28	.51	29.80	< .001
No	32	57	121	92	.30		
					.22		
		Time spent with data processing					
Computer							
Yes	34	36	106	106	1.62	41.12	< .001
No	58	38	55	34	3.29		
					5.32		
E-mail							
Yes	14	13	40	37	1.19	5.60	.20
No	78	61	121	103	1.84		
					2.00		
Internet							
Yes	17	24	54	70	2.12	28.77	< .001
No	75	50	107	70	2.23		
					4.41		

Table 34. Time distribution of work functions during previous week and computer technology access

CT/ %	0	1-25	26-50	51 +	OR	X^2	P value
		Time spent doing data analysis					
Computer							
Yes	11	177	78	16	.88	2.17	NS
No	7	128	42	8	1.18		
					1.27		
E-mail							
Yes	3	72	23	6	1.54	1.41	NS
No	15	233	97	18	1.18		
					1.67		
Internet							
Yes	7	102	43	13	.79	4.32	NS
No	11	203	77	11	.88		
					1.86		
		Time spent with planning & evaluation					
Computer	**0**	**1-25**	**51 +**				
Yes	23	228	31	1.21		.34	NS
No	18	147	20	1.21			
E-mail							
Yes	5	79	30	1.92		11.18	.01
No	36	296	31	4.64			
Internet							
Yes	11	124	30		1.35	15.44	< .001
No	30	251	21		3.89		
		Time spent doing research					
Computer	**0**	**1-25**	**51 +**				
Yes	137	137	8		.11	.34	NS
No	9	85	3		.17		
E-mail							
Yes	46	54	4		1.26	2.73	NS
No	188	168	7		2.33		
Internet							
Yes	83	78	4		.98	.01	NS
No	151	144	7		1.04		
		Time spent doing supervision					
Computer	**0**	**1-25**	**51 +**				
Yes	40	223	19		.44	8.85	< .025
No	12	152	21		.27		
E-mail							
Yes	18	76	10		.48	5.62	.10
No	34	299	30		.63		
Internet							
Yes	28	126	11	.43		9.37	< .01
No	24	249	29	.35			

Table 35. Networks and computer technology: discussions with other health personnel

Computer at work	Yes	No	OR	X^2	P value
ARIMAC					
None	51	43			
At least one time per month	76	52	1.23		
At least one time per week	83	53	1.32		
At least one time per day	28	21	1.12	1.13	NS
PH Coordinator					
None	75	49			
At least one time per month	120	88	.89		
At least one time per week	52	32	1.06		
At least one time per day	22	5	2.87	5.73	.20
Other epidemiologists					
None	83	62			
At least one time per month	122	70	1.30		
At least one time per week	29	28	.77		
At least one time per day	17	8	.70	4.10	NS
E-mail access					
ARIMAC					
None	12	82			
At least one time per month	23	105	1.50		
At least one time per week	34	102	2.28		
At least one time per day	11	38	1.98	5.76	.20
PH coordinator					
None	17	107			
At least one time per month	44	164	.89		
At least one time per week	21	63	1.06		
At least one time per day	14	13	2.87	19.70	<. 001
Other epidemiologists					
None	32	92			
At least one time per month	73	135	1.35		
At least one time per week	32	52	1.77		
At least one time per day	18	8	6.47	18.36	<. 001
Internet access					
ARIMAC					
None	22	72			
At least one time per month	38	90	1.38		
At least one time per week	49	87	1.84		
At least one time per day	18	31	1.90	4.97	.20
PH coordinator					
None	32	92			
At least one time per month	73	135	1.55		
At least one time per week	32	52	1.77		
At least one time per day	18	9	6.47	16.86	< .001
Other epidemiologists					
None	39	106			
At least one time per month	66	126	1.42		
At least one time per week	24	33	1.98		
At least one time per day	17	8	5.78	17.48	<. 001

There was no trend between the proportion of time that epidemiologists invested doing research activities and having or not having computer in the workplace as well as with Internet access. Epidemiologists with e-mail access tended to invest more of their work time doing research than those without; nevertheless the association was not significant. Table 34

The proportion of time doing supervision tended to decrease in epidemiologists who have computers at work in comparison with those who don't (X^2= 8.85 p< .025). The same situation was found with Internet access (X^2= 9.37 p< .01). There was no trend between supervision time and e-mail access. Table 34

In relation to epidemiologists' networks to discuss epidemiological issues with other health personnel, we found that there was no trend to keep closer networks with ARIMAC people related with having or not having computer, e-mail and Internet access. On the other hand, epidemiologists' networks with PH coordinators tended to be closer in those who have computers but the association was not significant. In contrast epidemiologists who have e-mail access tended to have closer networks than those who don't (X^2= 19.7 p< .001) as well with Internet access (X^2=16.86 p< .001). With other epidemiologists in the same position as them, there was no trend with epidemiologists who have computers and those who don't. Epidemiologists with e-mail access showed a positive trend to establish closer networks with other colleagues than those who don't (X^2= 18.36 p< .001); also there was a significant trend with Internet access (X^2= 17.48 p< .001). Table 35

Communications between departments and access to information technology showed that meetings with ARIMAC personnel were more frequent for epidemiologists who have access to computers than with those who don't (X^2= 18.60 p< .001) but with chairman, PH coordinator and other epidemiologists there were no significant associations. Epidemiologists who have e-mail access at work didn't show significant trends in the frequency of their meeting with ARIMAC people and chairmen. In contrast with other epidemiologists (X^2= 20.34 p< .001) and PH coordinators (X^2= 22.36 p< .001) there were very significant associations with those epidemiologists who have e-mail access. We found that epidemiologists who have Internet access had more meetings with other epidemiologists (X^2= 9.24 p< .05) and PH coordinators (X^2= 19.58 p< .001), but with ARIMAC and chairmen there was no trend. Table 36

In contrast, phones calls to the chairman from epidemiologists were more frequent with those who have computers at work than with those who don't (X2= 12.24 p< .01). The same situation was found with phone calls to other epidemiologists (X2= 10.25 p< .025). There were no trends with the PH coordinator and other epidemiologists. Epidemiologists who have e-mail access tend to call more to PH coordinators (X^2= 11.54 p< .01) and other epidemiologists (X^2= 10.31 p< .025) than those who don't; with the chairman the association was not significant. Finally, epidemiologists that have Internet access in their workplace showed a positive association for call their PH coordinators (X^2= 15.29 p< .01) and other epidemiologists (X^2= 8.93 p< .05) more often than those who don't; there was no association with the chairman. Table 37

Table 36. Communications between departments at workplace by computer technology access: meetings

	Computer			E-mail			Internet		
Meetings	**Yes/No**	**OR**	**X^2**	**Yes/No**	**OR**	**X^2**	**Yes/No**	**OR**	**X^2**
ARIMAC									
None	16/15			9/22			15/16		
At least one time per month	0/13			0/3			0/3		
At least one time per week	143/98	1.37		41/200	.50		70/171	.44	
At least one time per day	82/55	1.4	18.60$^{\&\&}$	33/104	.78	5.07$^{\&}$	47/90	.56	6.53$^{\&}$
CHAIRMAN									
None	12/15			4/23			10/17		
At least one time per month	3/1	16.25		1/3	1.92		2/2	1.7	
At least one time per week	145/97	.62		46/196	1.35		73/109	1.1385	
At least one time per day	80/65	1.54	3.28$^{\&}$	32/113	1.63	1.05$^{\&}$	48/97	.84	1.98$^{\&}$
OTHER EPIDEMIOLOGISTS									
None	45/35			5/75			16/64		
At least one time per month	18/12	1.67		6/24	3.75		9/21	1.71	
At least one time per week	143/95	1.17		64/174	5.52		89/149	2.39	
At least one time per day	12/14	.67	2.06$^{\&}$	11/15	11.0	20.34$^{\&\&}$	11/15	2.93	9.24$^{\&\&\&}$
PH COORDINATOR									
None	45/36			8/73			18/63		
At least one time per month	21/13	1.29		5/29	1.57		10/24	1.46	
At least one time per week	144/91	1.27		58/177	2.99		87/148	2.06	
At least one time per day	10/7	1.14	.88$^{\&}$	10/7	13.04	22.36$^{\&\&}$	13/4	11.37	19.58$^{\&\&}$

p-value: $^{\&}$ Non-significant, $^{\&\&}$ < .001, $^{\&\&\&}$< .05

Table 37. Communications between departments at workplace by computer technology access: phone calls

	Computer			E-mail			Internet		
Meetings	**Yes/No**	**OR**	**X^2**	**Yes/No**	**OR**	**X^2**	**Yes/No**	**OR**	**X^2**
CHAIRMAN									
None	40/53			14/79			23/70		
At least one time per month	1/1	1.32		1/1	4.65		2/0		
At least one time per week	125/80	2.07		45/160	1.31		69/136	1.54	
At least one time per day	62/31	2.65	12.24[&&]	19/74	1.19	3.03[&]	33/60	1.67	7.23[&]
OTHER EPIDEMIOLOGISTS									
None	19/22			5/36			10/31		
At least one time per month	6/3	2.32		1/8	.9		2/7	.87	
At least one time per week	173/120	1.67		56/237	1.70		92/201	1.42	
At least one time per day	45/19	2.74	6.27[&]	27/37	5.25	11.54[&&]	35/29	3.74	15.29[&&]
PH COORDINATOR									
None	30/39			7/62			17/52		
At least one time per month	5/5	1.3		0/10	1.19		1/9	.34	
At least one time per week	163/105	2.02		64/204	2.78		89/179	1.52	
At least one time per day	41/18	2.96	10.25[&&&]	18/41	3.89	10.31[&&&]	27/32	2.58	8.93[&&&&]

p-value: [&] Non-significant, [&&] < .01, [&&&]< .025, , [&&&&]< .05

Epidemiologists who had computers at work agreed 27% more with the accuracy of the communication channels than those who didn't, but the association was not significant. When they graded (from a scale of 1-10) this accuracy there was a positive trend but without significant association. In contrast, epidemiologists who had e-mail access agreed 2.24 more times with the accuracy of communication channels than those who didn't (X^2= 9.93, p= .002) and the trend was strongly positive to those epidemiologists who had e-mail access (X^2= 12.23, p< .01). Finally epidemiologists who had Internet access agreed 1.81 more times with the accuracy of communication channels than those who didn't and from a scale of 1 to 10 the chance to grade the communication channels more highly was stronger for those epidemiologists who had Internet access (X^2= 10.85, p< .01). Tables 38, 39

Table 38. Epidemiologists' opinion about the accuracy of the communication channels by computer technology

	Cases	OR	CI	X^2	P value
Computer					
Yes	89	1.27	.86-1.86	1.43	.23
No	114				
E-mail					
Yes	81	2.24	1.34-3.72	9.93	.002
No	222				
Internet					
Yes	121	1.81	1.20-2.75	7.99	< .005
No	182				

Table 39. Epidemiologists' opinion about the accuracy of communication channels (scale 1-10) by computer technology access

	1-5	6-7	8-10	OR	X^2	P value
Computer						
Yes	93	81	108	1.40	1.95	NS
No	71	44	70	1.78		
E-mail						
Yes	23	28	53	1.77	12.23	.01
No	141	97	125	2.60		
Internet						
Yes	44	43	78	1.43	10.85	.01
No	120	82	100	2.13		

6.7.2. Research and academic activities

With the exception of e-mail service there were statistically significant differences among epidemiologists who did research activities and those who didn't in relation with their access to information technology in their workplace. Epidemiologists who had computers at work did 1.65 times more research activities than those who didn't. Epidemiologists who had Internet access at work did 1.74 times more research activities than those who didn't. Epidemiologists who had Internet tools (Internet and e-mail) at work did 64% more research activities than those who didn't. Overall epidemiologists who had information technology (computer, Internet and e-mail) access at work did 1.29 times more research activities than those who didn't. Table 40

There were more epidemiologists with articles published in the groups of epidemiologists that have computer or information technology access at workplace than those who don't. Epidemiologists who have computer access at work had published 1.83 times more than those who don't and, epidemiologists than had information technology access at work have almost three times more likelihood to have articles published than those who didn't. There was no association with e-mail access. Table 41

There were no differences between epidemiologists that have or do not have students and their access to information technology in the workplace. Table 42

Table 40. Epidemiologists' scientific research activities done during the current year and Information technology access at workplace

	Scientific research activities									
	Yes			No						
	#	%	S.R.	#	%	S.R.	OR	C.I.	X 2	P-value
Computer										
Yes	109	68.1	1.3	173	56.4	-.9	1.65	1.11-2.47	6.09	.01
No	51	31.9	-1.6	134	43.6	1.1				
Total	160	100		307	100					
E-mail										
Yes	40	25.0	.7	64	20.8	-.5	1.27	.81-1.99	1.05	.31
No	120	75.0	-.4	243	79.2	.3				
Total	160	100		307	100					
Internet										
Yes	70	43.8	1.8	95	30.9	-1.3	1.74	1.17-2.58	7.55	.006
No	90	56.3	-1.3	212	69.1	1.0				
Total	160	100		307	100					
Internet tools										
I or E	72	45.0	1.6	102	33.2	-1.2	1.64	1.11-2.43	6.24	.01
I and E	88	55.0	-1.2	205	66.8	.9				
Total	160	100		307	100					
Information technology										
None	51	31.9	-1.6	134	43.6	1.1			10.8	.01
C	48	30.0	-.3	98	31.9	.2	1.98			
C & I	27	16.9	1.7	30	6.4	-1.2	2.36			
C, I & E	34	21.3	1.3	45	14.7	-1.0	1.29			
Total	160	100		307	100					

S.R.: Standard Residual, OR: Odds Ratio, C.I.: 95% Confidence interval, X2: Chi-square
C: Computer, E: e-mail, I: Internet

Table 41. Epidemiologists' articles published and Information technology access at workplace

	Articles published									
	Yes			No						
	#	%	S.R.	#	%	S.R.	OR	C.I.	X 2	P-value
Computer										
Yes	44	72.1	1.2	238	58.6	-.5	1.83	1.01-3.31	4.05	.04
No	17	27.9	-1.5	168	41.4	.6				
Total	61	100		406	100					
E-mail										
Yes	18	29.5	1.2	86	21.2	-.5	1.56	.85-2.84	2.12	.14
No	43	70.5	-.6	320	78.8	.2				
Total	61	100		406	100					
Internet										
Yes	61	30.7	-1.1	104	38.8	1.0	.7	.41-.03	3.32	.07
No	104	38.8	1.0	164	61.2	-.7				
Total	199	100		268	100					
Internet tools										
I or E	28	45.9	1.1	146	36.0	-.4	1.51	.88-2.6	2.42	.13
I and E	33	54.1	-.9	260	64.0	.3				
Total	61	100		406	100					
Information technology										
None	17	27.9	-1.5	168	36.0	.6			9.14	.03
C	18	29.5	-.2	128	27.4	.1	1.39			
C & I	8	13.1	.2	49	12.1	-.1	1.61			
C, I & E	18	3.9	2.4	61	13.1	-.9	2.92			
Total	61	100		406	100					

S.R.: Standard Residual, OR: Odds Ratio, C.I.: 95% Confidence interval, X2: Chi-square
C: Computer, E: e-mail, I: Internet

Table 42. Epidemiologists' students and Information technology access at workplace

	Have students									
	Yes			No						
	#	%	S.R.	#	%	S.R.	OR	C.I.	X 2	P-value
Computer										
Yes	109	54.8	-1.0	173	64.6	.9	.66	.46-.97	4.56	.03
No	90	45.2	1.3	95	35.4	-1.1				
Total	199	100		268	100					
E-mail										
Yes	39	19.6	-.8	65	24.3	.7	.76	.49-1.2	1.43	.23
No	160	80.4	.4	203	75.7	-.4				
Total	199	100		268	100					
Internet										
Yes	61	30.7	-1.1	104	38.8	1.0	.7	.41.03	3.32	.07
No	104	38.8	1.0	164	61.2	-.7				
Total	199	100		268	100					
Internet tools										
I or E	67	33.7	-.8	107	39.9	.7	.76	.52-1.12	1.91	.17
I and E	132	66.3	.6	161	34.5	-.6				
Total	199	100		268	100					
Information technology										
None	90	45.2	1.3	95	35.4	-1.1			5.87	.12
C	61	30.7	-.2	85	31.7	.1	.55			
C & I	21	10.6	-.7	36	13.4	.6	.62			
C, I & E	27	13.6	-1.1	52	11.1	1.0	.76			
Total	199	100		268	100					

S.R.: Standard Residual, OR: Odds Ratio, C.I.: 95% Confidence interval, X2: Chi-square
C: Computer, E: e-mail, I: Internet

6.7.3. Epidemiological information system

In relation to completed reports, epidemiologists who had computers in their workplace tended to send more daily (X^2=49.78, p< .001), weekly (X^2=12.50, p< .001) and monthly reports (X^2=12.30, p< .025) than those who didn't. Also, epidemiologists who had e-mail access sent more daily (X^2=6.48, p< .05), weekly (X^2=23.16, p< .001) and monthly reports (X^2=34.67, p< .001) than those who didn't. The same situation was found with Internet access for weekly (X^2=17.22, p< .01) and monthly reports (X^2=18.39, p< .01). Table 43

Epidemiologists who had computers received 1.47 more feedback than those who didn't but the association was not statistically significant (X^2=2.90, p= .09) and epidemiologists who had Internet access in their workplaces got 53% more feedback than those who didn't but also, the association was not significant (X^2=2.99, p= .08). In contrast, epidemiologists who had e-mail access at work received 2.21 more feedback than those who didn't (X^2=6.32, p= .012). Table 44

Epidemiologists' opinion about the accuracy of epidemiological information systems was not influenced by the fact of having or not having computer at work (X^2= 60.86, p< .001), e-mail access (X^2=1.94, p= .20) and Internet access (X^2=1.94, p= .16). Table 44

Epidemiologists who had computers agreed 23% more that notification channels are slow than those who didn't but the association was not statistically significant (X^2=1.20, p= .27) and those who had Internet access agreed 38% more about this statement than those who didn't but also in this case the association was not significant (X^2=2.65, p= .10). In contrast, epidemiologists who had e-mail access at workplace opined 68% more that notification channels are slow (X^2=5.36, p= .02) than those who didn't. Table 44

Epidemiologists who had computers opined 30% more that notification forms are accurate than those who didn't but the association was not statistically significant (X^2=1.31, p= .25). Also the association was not significant (X^2=. 69, p= .41) to those epidemiologists who had e-mail access. Epidemiologists who had Internet access at work agreed 1.54 more times with the accuracy of notification forms than those who didn't (X^2=3.83, p= .05). Table 44

Table 43. Frequency of completed reports in the epidemiological information systems and computer technology (CT) access

CT	Daily reports 0	1-5	6 +	OR	X^2	P value
Computer						
Yes	157	14	28	.15	49.78	.001
No	107	62	8	2.38		
E-mail						
Yes	53	33	14	1.13	6.48	.05
No	211	116	22	2.53		
Internet						
Yes	92	49	17	.92	6.91	.10
No	172	100	19	1.67		

CT	Weekly reports 0	1-5	6-20	21 +	OR	X^2	P value
Computer							
Yes	70	135	41	26	.52	12.50	< .01
No	31	115	24	7	.76		
					1.64		
E-mail	0	1-5	6-10	11 +			
Yes	22	42	9	27	.72	23.16	.001
No	79	208	30	32	1.08		
					3.03		
Internet	0	1-5	6-20	21 +			
Yes	43	71	26	19	.54	17.22	< .01
No	58	179	39	14	.90		
					1.83		

CT	Monthly reports 0	1-10	11-20	21 +	OR	X^2	P value
Computer							
Yes	74	79	46	44	.70	12.30	< .025
No	43	74	29	13	1.02		
					1.97		
E-mail							
Yes	21	31	11	27	.76	34.67	.001
No	96	187	36	21	1.40		
					3.98		
Internet							
Yes	43	68	15	33	.73	18.39	.01
No	74	160	32	25	.81		
					2.27		

Table 44. Opinions about the epidemiological information systems and computer technology access: Feedback and accuracy of the information systems, surveillance and health promotion activities

	Yes	No	OR	C. I.	X^2	P-value
	Feedback					
Computer	229	138	1.47	.94-2.30	2.9	.09
E-mail	91	276	2.21	1.18-4.14	6.32	.012
Internet	137	230	1.53	.94-2.49	2.99	.08
	Accuracy information System					
Computer	74	68	.07	.04-.14	73.44	<.001
E-mail	31	131	.71	.44-1.94	1.94	.20
Internet	139	244	1.56	.83-2.91	1.94	.16
	Notification channels are slow					
Computer	116	67	1.24	.84-1.81	1.20	.27
E-mail	51	132	1.68	1.08-2.60	5.36	.02
Internet	73	110	1.38	.94-2.03	2.65	.10
	Notification forms are accurate					
Computer	72	39	1.30	.83-2.02	1.32	.25
E-mail	28	83	1.23	.75-2.03	.69	.41
Internet	48	63	1.54	1.0-2.39	3.83	.05
	Health promotion activities					
Computer	255	177	.43	.19-.96	4.44	.03
E-mail	89	343	.35	.17-.70	9.26	.002
Internet	140	292	.19	.09-.41	21.58	.000

Table 45. Preventive Medicine activities and computer technology access: Immunizations

	Yes	No	OR	C. I.	X^2	P-value
	Coverage internal controls					
Computer	226	165	.82	.19-3.49	.07	NS
E-mail	84	307	1.91	.23-15.78	.38	NS
Internet	121	270	.75	.17-3.17	.16	NS
	Activities internal controls					
Computer	225	177	.18	.02-1.49	3.17	.10
E-mail	75	327	.69	.14-3.48	.21	NS
Internet	117	285	.41	.10-1.67	1.65	.20
	Supplies internal controls					
Computer	228	177	.14	.02-1.14	4.53	.05
E-mail	78	327	.36	.10-1.30	2.75	.20
Internet	119	286	.10	.02-.50	11.77	.001
	PROVAC is accurate					
Computer	209	131	3.99	1.97-8.07	16.59	.000
E-mail	82	258	1.03	1.76-96.21	10.39	.001
Internet	113	227	2.49	1.07-5.78	4.76	.03

Epidemiologists' opinions about performing health promotion activities were not influenced by having or not having computer at work (X^2= 4.44, p= .035), e-mail access (X^2=9.26, p= .002) and Internet access (X^2=21.58, p< .000). Table 44

Epidemiologists who had computers at work agreed almost four times more that the PROVAC system is accurate than those who didn't (X^2=16.59, p< .000). Also epidemiologists who had e-mail access opined 13 times more that the PROVAC system is accurate than those who didn't. Epidemiologists who had Internet access thought 2.49 times more that the PROVAC system is accurate than those who didn't. Table 45

Having computers, e-mail and Internet access at work did not influence epidemiologists in keeping internal controls to monitor immunizations and screening in their services. Table 45, 46

Epidemiologists who had computers at work have 4 times more registries of patients with Tuberculosis and 1.06 time more registries of malaria patients than those who didn't. There were no associations between having e-mail and Internet access and keeping registries of some diseases of epidemiological importance. Table 47

Table 46. Preventive Medicine activities and computer technology access: Screenings

	Yes	No	OR	C. I.	X^2	P-value
	Coverage internal controls					
Computer	233	174	.17	.02-1.35	3.62	.10
E-mail	88	319	.55	.13-2.25	.71	NS
Internet	130	277	.59	.15-2.22	.63	NS
	Activities internal controls					
Computer	228	177	.37	.07-1.79	1.65	.20
E-mail	82	323	.51	.14-2.07	.92	NS
Internet	124	281	.22	.05-.89	5.31	.025

Table 47. Preventive Medicine activities and computer technology access: Disease treatment and control registries

	Yes	No	OR	C. I.	X^2	P-value
	Tuberculosis					
Computer	221	165	4.02	1.07-15.07	4.92	.03
E-mail	79	307	1.29	.28-5.99	.10	.75
Internet	116	270	2.15	.46-9.96	1.0	.32
	Sexually transmitted diseases					
Computer	194	147	1.23	.70-2.16	.51	.47
E-mail	67	274	.73	.38-1.42	.85	.36
Internet	100	241	.88	.48-1.61	.18	.67
	Malaria					
Computer	103	61	1.06	1.06-2.39	4.99	.02
E-mail	38	126	1.33	.82-2.18	1.32	.25
Internet	54	110	1.30	.84-2.00	1.37	.24
	Rheumatic fever					
Computer	90	64	1.16	.77-1.75	.53	.47
E-mail	30	124	.91	.55-1.51	.13	.71
Internet	38	116	.67	.42-1.05	3.07	.08

6.7.4. Desirability of computer applications

In relation to the possibility of having computer systems in the workplace, epidemiologists who had computers thought almost four times more that the computer system will be accurate than those who didn't, also eleven more times that the computer system will be successful, five times more that they will use it and 68% more that other PH personnel will use this system. Epidemiologists who had e-mail access agreed almost four times more that computer systems will be accurate than those who didn't, also 2 times more that computer systems will be successful but none of these associations where statistically significant. In contrast, it was significant that those epidemiologists who had e-mail access thought three times more that they would use it than those who didn't; and there was no association in relation to other PH personnel would use this system. We found that epidemiologists who had Internet access thought that the computer systems will be accurate 3.37 more times than those who didn't, 4.46 more times that they will use it, 3.89 more times that the system will be successful and 2.74 more times that other PH personnel will use it, but only the last association was significant (X^2=6.72, p= .010). Table 48

Table 48. New computer system in the workplace and computer technology access

	Yes	No	OR	C. I.	X^2	P-value
	Computer system will be accurate					
Computer	278	175	3.97	1.23-12.86	6.11	.01
E-mail	103	350	3.83	.49-29.59	1.91	.17
Internet	163	290	3.37	.75-15.25	2.80	.09
	Epidemiologists will use the computer system					
Computer	280	178	5.51	1.12-26.80	5.59	.02
E-mail	103	355	2.32	.29-18.77	.66	.42
Internet	164	294	4.46	.55-35.99	2.36	.12
	Other PH personnel will use the computer system					
Computer	260	162	1.68	.91-3.11	2.75	.01
E-mail	100	322	3.18	1.11-9.10	5.15	.02
Internet	157	265	2.74	1.24-6.03	6.72	.01
	The computer system will be successful					
Computer	281	178	11.02	1.35-90.57	7.80	.005
E-mail	102	357	.86	.17-4.31	.03	.85
Internet	164	295	3.90	.47-31.90	1.86	.17

We didn't find differences among information technology access and epidemiologists' agreement about the convenience of computer applications on patient care issues (Table 49). There were no differences among information technology access at workplace and epidemiologists' proportion of agreement or not about convenience of computer applications on medical decision tools (Table 50). Also there were no differences among information technology access and epidemiologists' agreement about convenience of computer applications on physician substitute issues. Table 51

There were no differences regarding information technology access at work and epidemiologists' agreement about consequences of the use of computer applications on cost and quality care tools. Table 52

We did not find differences regarding information technology access and epidemiologists agreement about consequences of the use of computer applications on epidemiologists' autonomy, physician role, medical manpower and organization tools. Tables 53-56

On the other hand, there were no differences among epidemiologists' age groups and their opinions about consequences of the use of computer applications. Older epidemiologists disagreed more with epidemiologists' autonomy computer applications than those of the same age, who agreed. There were more young epidemiologists who disagreed with organization computer applications than those of the same age that agreed. Table 57

There were no statistically significant differences among epidemiologists' gender and their opinions about convenience of computer applications. Table 58

Table 49. Epidemiologists' opinions about convenience of computer applications on patient care by information technology access at workplace

	Opinions about patient care computer applications										
	Disagree			Not sure			Agree				
	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
Computer											
Yes	74	54.8	-.8	63	63.0	.3	145	62.5	.4	2.47	.29
No	61	45.2	1.0	37	37.0	-.4	87	37.5	-.5		
Total	135	100		100	100		232	100			
E-mail											
Yes	25	18.5	-.9	26	26.0	.8	53	22.8	.2	1.95	.38
No	110	81.5	.5	74	74.0	-.4	179	77.2	-.1		
Total	135	100		100	100		232	100			
Internet											
Yes	43	31.9	-.7	39	39.0	.6	83	35.8	.1	1.32	.52
No	92	68.1	.5	61	61.0	-.5	149	64.2	-.1		
Total	135	100		100	100		232	100			
Internet tools											
I or E	45	33.3	-.7	43	43.0	.9	86	37.1	.0	2.30	.32
I and E	90	66.7	.6	57	57.0	-.7	146	62.9	.0		
Total	135	100		100	100		232	100			
Information technology											
None	61	45.2	1.0	37	37.0	-.4	87	37.5	-.5	5.03	.54
Computer	42	31.1	.0	31	31.0	.0	73	31.5	.1		
C and I	14	10.4	-.6	16	16.0	1.1	27	11.6	-.2		
C, I and E	18	13.3	-1.0	16	16.0	-.2	45	19.4	.9		
Total	135	100		100	100		232	100			

S.R.: Standard Residual, X2: Chi-square
C: Computer, E: e-mail, I: Internet

Table 50. Epidemiologists' opinions about convenience of computer applications on medical decision making by information technology access at workplace

	Opinions about medical decision making computer applications										
	Disagree			Not sure			Agree				
	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
Computer											
Yes	66	57.4	-.4	66	66.7	.8	150	59.3	-.2	2.19	.33
No	49	42.6	.5	33	33.3	-1.0	103	40.7	.3		
Total	115	100		99	100		253	100			
E-mail											
Yes	24	20.9	-.3	26	26.3	.8	54	21.3	-.3	1.17	.56
No	91	79.1	.2	73	73.7	-.5	199	78.7	.2		
Total	115	100		99	100		253	100			
Internet											
Yes	41	35.7	.1	40	40.4	.8	84	33.2	-.6	1.62	.44
No	74	64.3	.0	59	59.6	-.6	169	66.8	.4		
Total	115	100		99	100		253	100			
Internet tools											
I or E	43	37.4	.0	44	44.4	1.2	87	34.4	-.7	3.08	.21
I and E	72	62.6	.0	55	55.6	-.9	166	65.6	.6		
Total	115	100		99	100		253	100			
Information technology											
None	49	42.6	.5	33	33.3	-1.0	103	40.7	.3	4.45	.62
Computer	34	29.6	-.3	31	31.3	.0	81	32.0	.2		
C and I	14	12.2	.0	17	17.2	1.4	26	10.3	-.9		
C, I and E	18	15.7	-.3	18	18.2	.3	43	17.0	.0		
Total	115	100		99	100		253	100			

S.R.: Standard Residual, X2: Chi-square
C: Computer, E: e-mail, I: Internet

Table 51. Epidemiologists' opinions about convenience of computer applications on physician substitute by information technology access at workplace

	Opinions about physician substitute computer applications										
	Disagree			Not sure			Agree				
	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
Computer											
Yes	85	56.3	-.6	99	64.3	.6	98	60.5	.0	2.04	.36
No	66	43.7	.8	55	35.7	-.8	64	39.5	.0		
Total	151	100		154	100		162	100			
E-mail											
Yes	29	19.2	-.8	31	20.1	-.6	44	27.2	1.3	3.46	.18
No	122	80.8	.4	123	79.9	.3	118	72.8	-.7		.
Total	151	100		154	100		162	100			
Internet											
Yes	54	35.8	.1	53	34.4	-.2	58	35.8	.1	.08	.96
No	97	64.2	-.1	101	65.6	.1	104	64.2	-.1		
Total	151	100		154	100		162	100			
Internet tools											
I or E	56	37.1	.0	55	35.7	-.3	63	38.9	.3	.34	.84
I and E	95	62.9	.0	99	64.3	.2	99	61.1	-.3		
Total	151	100		154	100		162	100			
Information technology											
None	66	43.7	.8	55	35.7	-.8	64	39.5	.0	6.81	.34
Computer	45	29.8	-.3	55	35.7	1.0	46	28.4	-.7		
C and I	20	13.2	.4	20	13.0	.3	17	10.5	-.6		
C, I and E	20	13.2	-1.1	24	15.6	-.4	35	21.6	1.5		
Total	151	100		154	100		162	100			

S.R.: Standard Residual, X2: Chi-square
C: Computer, E: e-mail, I: Internet

Table 52. Epidemiologists' opinions about convenience of computer applications on cost and quality care by information technology access at workplace

	Opinions about cost and quality care computer applications										
	Disagree			Not sure			Agree				
	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
Computer											
Yes	74	56.9	-.5	87	65.9	.8	121	59.0	-.3	2.49	.29
No	56	43.1	.6	45	34.1	-1.0	84	41.0	.3		
Total	130	100		132	100		205	100			
E-mail											
Yes	27	20.8	-.4	33	25.0	.7	44	21.5	-.2	.81	.66
No	103	79.2	.2	99	75.0	-.4	161	78.5	.1		
Total	130	100		132	100		205	100			
Internet											
Yes	44	33.8	-.3	50	37.9	.5	71	34.6	-.2	.54	.76
No	86	66.2	.2	82	62.1	-.4	134	65.4	.1		
Total	130	100		132	100		205	100			
Internet tools											
I or E	47	36.2	-.2	53	40.2	.5	74	36.1	-.3	.66	.72
I and E	83	63.8	.2	79	59.8	-.4	131	63.9	.2		
Total	130	100		132	100		205	100			
Information technology											
None	56	43.1	.6	45	34.1	-1.0	84	41.0	.3	2.89	.82
Computer	39	30.0	-.3	44	33.3	.4	63	30.7	-.1		
C and I	16	12.3	.0	17	12.9	.2	24	11.7	-.2		
C, I and E	19	14.6	-.6	26	19.7	.8	34	16.6	-.1		
Total	130	100		132	100		205	100			

S.R.: Standard Residual, X2: Chi-square
C: Computer, E: e-mail, I: Internet

Table 53. Epidemiologists' opinions about convenience of computer applications on epidemiologists' autonomy by information technology access at workplace

	Opinions about epidemiologists' autonomy computer applications										
	Disagree			Not sure			Agree				
	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
Computer											
Yes	70	54.7	-.8	95	62.5	.3	117	62.6	.4	2.39	.30
No	58	45.3	1.0	57	37.5	-.4	70	37.4	-.5		
Total	128	100		152	100		187	100			
E-mail											
Yes	24	18.8	-.8	43	28.3	1.6	37	19.8	-.7	4.76	.09
No	104	81.3	.5	109	71.7	-.8	150	80.2	.4		
Total	128	100		152	100		187	100			
Internet											
Yes	39	30.5	-.9	65	42.8	1.5	61	32.6	-.6	5.60	.06
No	89	69.5	.7	87	57.2	-1.1	126	67.4	.5		
Total	128	100		152	100		187	100			
Internet tools											
I or E	43	33.6	-.7	67	44.1	1.4	64	34.2	-.7	4.50	.11
I and E	85	66.4	.5	85	55.9	-1.1	123	65.8	.5		
Total	128	100		152	100		187	100			
Information technology											
None	58	45.3	1.0	57	37.5	-.4	70	37.4	-.5	6.25	.40
Computer	36	28.1	-.6	45	29.6	-.4	65	34.8	.9		
C and I	17	13.3	.3	17	11.2	-.4	23	12.3	.0		
C, I and E	17	13.3	-1.0	33	21.7	1.4	29	15.5	-.5		
Total	128	100		152	100		187	100			

S.R.: Standard Residual, X2: Chi-square
C: Computer, E: e-mail, I: Internet

Table 54. Epidemiologists' opinions about convenience of computer applications on physician role by information technology access at workplace

	Opinions about physician role computer applications										
	Disagree			Not sure			Agree				
	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
Computer											
Yes	67	54.5	-.8	123	66.8	1.1	92	57.5	-.5	5.57	.06
No	56	45.5	1.0	61	33.2	-1.4	68	42.5	.6		
Total	123	100		184	100		160	100			
E-mail											
Yes	23	18.7	-.8	43	23.4	.3	38	23.8	.4	1.24	.54
No	100	81.3	.4	141	76.6	-.2	122	76.3	-.2		
Total	123	100		184	100		160	100			
Internet											
Yes	40	32.5	-.5	70	38.0	.6	55	34.4	-.2	1.08	.58
No	83	67.5	.4	114	62.0	-.5	105	65.6	.2		
Total	123	100		184	100		160	100			
Internet tools											
I or E	42	34.1	-.6	75	40.8	.8	57	35.6	-.3	1.66	.44
I and E	81	65.9	.4	109	59.2	-.6	103	64.4	.3		
Total	123	100		184	100		160	100			
Information technology											
None	56	45.5	1.0	61	33.2	-1.4	68	42.5	.6	5.97	.43
Computer	35	28.5	-.6	65	35.3	1.0	46	28.8	-.6		
C and I	14	11.4	-.3	25	13.6	.5	18	11.3	-.3		
C, I and E	18	14.6	-.6	33	17.9	.3	28	17.5	.2		
Total	123	100		184	100		160	100			

S.R.: Standard Residual, X2: Chi-square
C: Computer, E: e-mail, I: Internet

Table 55. Epidemiologists' opinions about convenience of computer applications on medical manpower by information technology access at workplace

	Opinions about medical manpower computer applications										
	Disagree			Not sure			Agree				
	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
Computer											
Yes	71	60.2	.0	85	63.9	.5	126	58.3	-.4	1.07	.58
No	47	39.8	.0	48	36.1	-.6	90	41.7	.5		
Total	118	100		133	100		216	100			
E-mail											
Yes	28	23.7	.3	22	16.5	-1.4	54	25.0	.9	3.60	.17
No	90	76.3	-.2	111	83.5	.7	162	75.0	-.5		
Total	118	100		133	100		216	100			
Internet											
Yes	38	32.2	-.6	48	36.1	.1	79	36.6	.3	.68	.71
No	80	67.8	.4	85	63.9	-.1	137	63.4	-.2		
Total	118	100		133	100		216	100			
Internet tools											
I or E	41	34.7	-.4	50	37.6	.1	83	38.4	.3	.45	.8
I and E	77	65.3	.3	83	62.4	.0	133	61.6	-.2		
Total	118	100		133	100		216	100			
Information technology											
None	47	39.8	.0	48	36.1	-.6	90	41.7	.5	8.21	.22
Computer	39	33.1	.3	47	35.3	.8	60	27.8	-.9		
C and I	12	10.2	-.6	22	16.5	1.4	23	10.6	-.7		
C, I and E	20	16.9	.0	16	12.0	-1.4	43	19.9	1.1		
Total	118	100		133	100		216	100			

S.R.: Standard Residual, X2: Chi-square
C: Computer, E: e-mail, I: Internet

Table 56. Epidemiologists' opinions about consequences of computer applications on organization in public health field by information technology access at workplace

	Opinions about organization computer applications										
	Disagree			Not sure			Agree				
	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
Computer											
Yes	88	59.9	-.1	75	55.1	-.8	119	64.7	.7	2.99	.22
No	59	40.1	.1	61	44.9	1.0	65	35.3	-.9		
Total	147	100		136	100		184	100			
E-mail											
Yes	32	21.8	-.1	31	22.8	.1	41	22.3	.0	.04	.98
No	115	78.2	.1	105	77.2	-.1	143	77.7	.0		
Total	147	100		136	100		184	100			
Internet											
Yes	48	32.7	-.5	49	36.0	.1	68	37.0	.4	.70	.70
No	99	67.3	.4	87	64.0	-.1	116	63.0	-.3		
Total	147	100		136	100		184	100			
Internet tools											
I or E	49	33.3	-.8	54	39.7	.5	98	66.7	.6	1.46	.48
I and E	98	66.7	.6	82	60.3	-.4	113	61.4	-.2		
Total	147	100		136	100		184	100			
Information technology											
None	59	40.1	.1	61	44.9	1.0	65	35.3	-.9	5.45	.49
Computer	51	34.7	.7	38	27.9	-.7	57	31.0	-.1		
C and I	14	9.5	-.9	16	11.8	-.1	27	14.7	1.0		
C, I and E	23	15.6	-.4	21	15.4	-.4	35	19.0	.7		
Total	147	100		136	100		184	100			

S.R.: Standard Residual, X2: Chi-square
C: Computer, E: e-mail, I: Internet

Also there were no statistically significant differences among epidemiologists' job position time and their agreement about convenience of computer applications. There were more epidemiologists working more than 15 years in the same position that were not sure about their opinions on medical manpower computer tools than epidemiologists with the same time working who agreed, but also, there were more epidemiologists that have been working less than one year that disagreed with this application than epidemiologists who agreed. Table 59

There were no statistically significant differences among epidemiologists' time working in the IMSS and their agreement about the convenience of computer applications. As well there were more epidemiologists that have been working more than 20 years that disagreed about patient care computer tools than epidemiologists in the same time rank who agreed. Epidemiologists that have been working between 5.01-10.0 years disagreed more about their opinion of medical decision making and physician substitute computer applications than epidemiologists in the same time rank who agreed. There were more epidemiologists that have been working less than 1 year that disagreed about epidemiologists' autonomy and medical manpower computer tools than epidemiologists with the same time working in the IMSS who agreed. In all these cases the differences were not statistically significant. Table 60

Finally there were no significant differences among epidemiologists' job position in the IMSS and their agreement about convenience of computer applications. Only there were more epidemiologists from the normative level that were not sure about their opinions on epidemiologists' autonomy computer applications than epidemiologists in the same position who agreed or disagreed. Table 61

Table 57. Epidemiologists' opinions about convenience of computer applications by grouped age

	Opinions about computer applications										
	Disagree			Not sure			Agree				
Age group	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
	Patient care										
30-39	16	11.9	.0	16	16.0	1.2	23	9.9	-.8	2.51	.64
40-49	80	59.3	.0	57	57.0	-.3	140	60.3	.2		
50 +	39	28.9	.0	27	27.0	-.4	69	29.7	.2		
Total	135	100		100	100		232	100			
	Medical decision making										
30-39	10	8.7	-1.0	15	15.2	1.0	30	11.9	.0	4.30	.37
40-49	74	64.3	.7	51	51.5	-1.0	152	60.1	.2		
50 +	31	27.0	-.4	33	33.3	.8	71	28.1	-.2		
Total	115	100		99	100		253	100			
	Physician substitute										
30-39	16	10.6	-.4	21	13.6	.7	18	11.1	-.2	5.13	.27
40-49	100	66.2	1.1	84	54.5	-.8	93	57.4	-.3		
50 +	35	23.2	-1.3	49	31.8	.7	51	31.5	.6		
Total	151	100		154	100		162	100			
	Cost and quality care										
30-39	15	11.5	-.1	13	9.8	-.6	27	13.2	.6	.89	.93
40-49	78	60.0	.1	80	60.6	.2	119	58.0	-.2		
50 +	37	28.5	-.1	39	29.5	.1	59	28.8	.0		
Total	130	100		132	100		205	100			
	Epidemiologists autonomy										
30-39	13	10.2	-.5	19	12.5	.3	23	12.3	.2	5.41	.25
40-49	68	53.1	-.9	92	60.5	.2	117	62.6	.6		
50 +	47	36.7	1.6	41	27.0	-.4	47	25.1	-1.0		
Total	128	100		152	100		187	100			
	Physicians' role										
30-39	14	11.4	-.1	20	10.9	-.4	21	13.1	.5	2.71	.61
40-49	67	54.5	-.7	113	61.4	.4	97	60.6	.2		
50 +	42	34.1	1.1	51	27.7	-.3	42	26.3	-.6		
Total	123	100		184	100		160	100			
	Medical manpower										
30-39	18	15.3	1.1	18	13.5	.6	19	8.8	-1.3	3.65	.45
40-49	68	57.6	-.2	77	57.9	-.2	132	61.1	.3		
50 +	32	27.1	-.4	38	28.6	-.1	65	30.1	.3		
Total	118	100		133	100		216	100			
	Organization										
30-39	25	17.0	1.8	13	9.6	-.8	17	9.2	-1.0	5.85	.21
40-49	84	57.1	-.3	82	60.3	.1	11	60.3	.2		
50 +	38	25.9	-.7	41	30.1	.3	56	30.4	.4		
Total	147	100		136	100		184	100			

S.R.: Standard Residual, X2: Chi-square

Table 58. Epidemiologists' opinions about convenience of computer applications by gender

	Opinions about computer applications										
	Disagree			**Not sure**			**Agree**				
Gender	**#**	**%**	**S.R.**	**#**	**%**	**S.R.**	**#**	**%**	**S.R.**	**X^2**	**p-value**
	Patient care										
Female	47	34.8	.0	37	37.0	.4	78	33.6	-.3	.35	.84
Male	88	65.2	.0	63	63.0	-.3	154	66.4	.2		
Total	135	100		100	100		232	100			
	Medical decision making										
Female	42	36.5	.3	29	29.3	-.9	91	36.0	.3	1.63	.44
Male	73	63.5	-.2	70	70.7	.7	162	64.0	-.3		
Total	115	100		99	100		253	100			
	Physician substitute										
Female	53	35.1	.1	56	36.4	.4	53	32.7	-.4	.48	.79
Male	98	64.9	-.1	98	63.6	-.3	109	67.3	.3		
Total	151	100		154	100		162	100			
	Cost and quality care										
Female	45	34.6	.0	47	35.6	.2	70	34.1	-.1	.08	.96
Male	85	65.4	.0	85	64.4	-.1	135	65.9	.1		
Total	130	100		132	100		205	100			
	Epidemiologists autonomy										
Female	41	32.0	-.5	58	38.2	.7	63	33.7	-.2	1.29	.52
Male	87	68.0	.4	94	61.8	-.5	124	66.3	.2		
Total	128	100		152	100		187	100			
	Physicians role										
Female	40	32.5	-.4	62	33.7	-.2	60	37.5	.6	.89	.64
Male	83	67.5	.3	122	66.3	.2	100	62.5	-.4		
Total	123	100		184	100		160	100			
	Medical manpower										
Female	34	28.8	-1.1	52	39.1	.9	76	35.2	.1	2.96	.23
Male	84	71.2	.8	81	60.9	-.6	140	64.8	-.1		
Total	118	100		133	100		216	100			
	Organization										
Female	51	34.7	.0	50	36.8	.4	61	33.2	-.4	.45	.80
Male	96	65.3	.0	86	63.2	-.3	123	66.8	.3		
Total	147	100		136	100		184	100			

S.R.: Standard Residual, X2: Chi-square

Table 59. Epidemiologists' opinions about convenience of computer applications by job position time

	Opinions about computer applications										
	Disagree			Not sure			Agree				
Job position time	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
	Patient care										
0.01-1.0	14	10.4	-.4	11	11.0	-.2	29	12.5	.4	4.89	.77
1.01-5.0	33	24.4	-.6	27	27.0	.0	66	28.4	.4		
5.01-10.0	33	24.4	.2	30	30.0	1.3	48	20.7	-1.0		
10.01-15.0	39	28.9	.7	22	22.0	-.8	60	25.9	.0		
15 +	16	3.4	.0	10	10.0	-.5	29	12.5	.3		
Total	135	100		100	100		232	100			
	Medical decision making										
0.01-1.0	11	9.6	-.6	8	8.1	-1.0	35	7.5	1.1	9.42	.31
1.01-5.0	33	28.7	.4	22	22.2	-.9	71	28.1	.3		
5.01-10.0	29	25.2	.3	28	28.3	.9	54	21.3	-.8		
10.01-15.0	34	29.6	.8	27	27.3	.3	60	23.7	-.7		
15 +	8	7.0	-1.5	14	14.1	.7	33	13.0	.6		
Total	115	100		99	100		253	100			
	Physician substitute										
0.01-1.0	20	13.2	.6	14	9.1	-.9	20	12.3	.3	5.17	.74
1.01-5.0	41	27.2	.0	39	25.3	-.4	46	28.4	.3		
5.01-10.0	34	22.5	-.3	42	27.3	.9	35	21.6	-.6		
10.01-15.0	36	23.8	-.5	45	29.2	.8	40	24.7	-.3		
15 +	20	13.2	.5	14	9.1	-1.0	21	13.0	.4		
Total	151	100		154	100		162	100			
	Cost and quality care										
0.01-1.0	14	10.8	-.3	13	9.8	-.6	27	13.2	.7	3.93	.86
1.01-5.0	30	23.1	-.9	35	26.5	-.1	61	29.8	.8		
5.01-10.0	33	25.4	.4	35	26.5	.6	43	21.0	-.8		
10.01-15.0	36	27.7	.4	34	25.8	.0	51	24.9	-.3		
15 +	17	13.1	.4	15	11.4	-.1	23	11.2	-.2		
Total	130	100		132	100		205	100			
	Epidemiologists' autonomy										
0.01-1.0	11	8.6	-1.0	18	11.8	.1	25	13.4	.7	7.51	.48
1.01-5.0	27	21.1	-1.3	46	30.3	.8	53	28.3	.4		
5.01-10.0	35	27.3	.8	38	25.0	.3	38	20.3	-1.0		
10.01-15.0	38	29.7	.8	34	22.4	-.9	49	26.2	.1		
15 +	17	13.3	.5	16	10.5	-.4	22	11.8	.0		
Total	128	100		152	100		187	100			

Table 59. Continued

Job position time	Opinions about computer applications										
	Disagree			Not sure			Agree				
	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
	Physicians role										
0.01-1.0	17	13.8	.7	18	9.8	-.7	19	11.9	.1	5.14	.74
1.01-5.0	28	22.8	-.9	55	29.9	.8	43	26.9	.0		
5.01-10.0	26	21.1	-.6	49	26.6	.8	36	22.5	-.3		
10.01-15.0	35	28.5	.6	43	23.4	-.7	43	26.9	.2		
15 +	17	13.8	.7	19	10.3	-.6	19	11.9	.0		
Total	123	100		184	100		160	100			
	Medical manpower										
0.01-1.0	20	16.9	1.7	10	7.5	-1.4	24	11.1	-.2	15.27	.054
1.01-5.0	30	25.4	-.3	38	28.6	.4	58	26.9	.0		
5.01-10.0	20	16.9	-1.5	34	25.6	.4	57	26.4	.8		
10.01-15.0	35	29.7	.8	28	21.1	-1.1	58	26.9	.3		
15 +	13	11.0	-.2	23	17.3	1.9	19	8.8	-1.3		
Total	118	100		133	100		216	100			
	Organization										
0.01-1.0	17	11.6	.0	14	10.3	-.4	23	12.5	.4	2.41	.97
1.01-5.0	38	25.9	-.3	35	25.7	-.3	53	28.8	.5		
5.01-10.0	37	25.2	.3	31	22.8	-.2	43	23.4	-.1		
10.01-15.0	39	26.5	.1	36	26.5	.1	46	25.0	-.2		
15 +	16	10.9	-.3	20	14.7	1.0	19	10.3	-.6		
Total	147	100		136	100		184	100			

S.R.: Standard Residual, X2: Chi-square

Table 60. Epidemiologists' opinions about convenience of computer applications by time working in the IMSS

	Opinions about computer applications										
	Disagree			Not sure			Agree				
IMSS time	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
	Patient care										
0.01-5.0	15	11.1	-.1	11	11.0	-.1	27	11.6	.1	9.97	.27
5.01-10.0	22	16.3	.5	17	17.0	-.1	27	11.6	.1		
10.01-15.0	52	38.5	-.6	51	51.0	1.4	93	40.1	-.4		
15.01-20.0	31	23.0	-.6	16	16.0	-1.0	50	21.6	.3		
20.01 +	15	11.1	.0	5	5.0	-1.8	32	13.8	1.2		
Total	135	100		100	100		232	100			
	Medical decision making										
0.01-5.0	14	12.2	.3	7	7.1	-1.3	32	12.6	.6	10.44	.23
5.01-10.0	24	20.9	1.7	16	16.2	.4	29	11.5	-1.4		
10.01-15.0	45	39.1	-.5	46	46.5	.7	105	41.5	-.1		
15.01-20.0	24	20.9	.0	19	19.2	-.3	54	21.3	.2		
20.01 +	8	7.0	-1.3	11	11.1	.0	33	13.0	.9		
Total	115	100		99	100		253	100			
	Physician substitute										
0.01-5.0	18	11.9	.2	17	11.0	-.1	18	11.1	-.1	12.54	.13
5.01-10.0	31	20.5	1.8	18	11.7	-1.0	20	12.3	-.8		
10.01-15.0	54	35.8	-1.2	78	50.6	1.7	64	39.5	-.5		
15.01-20.0	32	21.2	.1	25	16.2	-1.2	40	24.7	1.1		
20.01 +	16	10.6	-.2	16	10.4	-.3	20	12.3	5		
Total	151	100		154	100		162	100			
	Cost and quality care										
0.01-5.0	14	10.8	-.2	15	11.4	.0	24	11.7	.2	5.46	.71
5.01-10.0	19	14.6	.0	22	16.7	.6	28	13.7	-.4		
10.01-15.0	59	45.4	.6	52	39.4	-.5	85	41.5	-.1		
15.01-20.0	24	18.5	-.6	33	25.0	1.1	40	19.5	-.4		
20.01 +	14	10.8	-.1	10	7.6	-1.2	28	13.7	1.1		
Total	130	100		132	100		205	100			
	Epidemiologists autonomy										
0.01-5.0	7	5.5	-2.0	21	13.8	.9	25	13.4	.8	7.66	.47
5.01-10.0	21	16.4	.5	22	14.5	-.1	26	13.9	-.3		
10.01-15.0	57	44.5	.4	62	40.8	-.2	77	41.2	-.2		
15.01-20.0	29	22.7	.5	33	21.7	.3	35	18.7	-.6		
20.01 +	14	10.9	-.1	14	9.2	-.7	24	12.8	.7		
Total	128	100		152	100		187	100			
	Physician role										
0.01-5.0	13	10.6	-.3	21	11.4	.0	19	11.9	.2	7.43	.49
5.01-10.0	14	11.4	-1.0	27	14.7	.0	28	17.5	.9		
10.01-15.0	60	48.8	1.2	79	42.9	.2	57	35.6	-1.2		
15.01-20.0	26	21.1	.1	38	20.7	.0	33	20.6	.0		
20.01 +	10	8.1	-1.0	19	10.3	-.3	23	14.4	1.2		
Total	123	100		184	100		160	100			

Table 60. (Continued)

	Opinions about computer applications										
	Disagree			**Not sure**						**Agree**	
IMSS time	**#**	**%**	**SR**	**#**	**%**	**SR**	**#**	**%**	**SR**	**X2**	**p-value**
	Medical manpower										
0.01-5.0	22	18.6	2.4	14	10.5	-.3	17	7.9	-1.5	11.28	.19
5.01-10.0	18	15.3	.1	18	13.5	-.4	33	15.3	.2		
10.01-15.0	44	37.3	-.8	54	40.6	-.2	98	45.4	.8		
15.01-20.0	20	16.9	-.9	30	22.6	.5	47	21.8	.3		
20.01 +	14	11.9	.2	17	12.8	.6	21	9.7	-.6		
Total	118	100		133	100		216	100			
	Organization										
0.01-5.0	21	14.3	1.1	14	10.3	-.4	18	9.8	-.6	11.30	.18
5.01-10.0	29	19.7	1.6	21	15.4	.2	19	10.3	-1.6		
10.01-15.0	57	38.8	-.6	54	39.7	-.4	85	46.2	.9		
15.01-20.0	23	15.6	-1.4	30	22.1	.3	44	23.9	.9		
20.01 +	17	11.6	.2	17	12.5	.5	18	9.8	-.5		
Total	147	100		136	100		184	100			

S.R.: Standard Residual, X2: Chi-square

Table 61. Epidemiologists' opinions about convenience of computer applications by job position

	Opinions about computer applications										
	Disagree			Not sure			Agree				
Job position	#	%	S.R.	#	%	S.R.	#	%	S.R.	X^2	p-value
	Patient care										
PCU	63	46.7	-.2	47	47.0	-.1	114	49.1	.3	4.69	.32
Hospitals	50	37.0	1.2	33	33.0	.3	64	27.6	-1.1		
Normative	22	16.3	-1.1	20	20.0	-.1	54	23.3	.9		
Total	135	100		100	100		232	100			
	Medical decision making										
PCU	53	46.1	-.3	48	48.5	.1	123	48.6	.1	3.84	.43
Hospitals	43	37.4	1.1	32	32.3	.1	72	28.5	-.9		
Normative	19	16.5	-1.0	19	19.2	-.3	58	22.9	.8		
Total	115	100		99	100		253	100			
	Physician substitute										
PCU	75	49.7	.3	76	49.4	.2	73	45.1	-.5	3.51	.48
Hospitals	48	31.8	.1	51	33.1	.4	48	29.6	-.4		
Normative	28	18.5	-.5	27	17.5	-.8	41	25.3	1.3		
Total	151	100		154	100		162	100			
	Cost and quality care										
PCU	59	45.4	-.4	58	43.9	-.7	107	52.2	.9	4.22	.38
Hospitals	47	36.2	1.0	42	31.8	.1	58	28.3	-.8		
Normative	24	18.5	-.5	32	24.2	.9	40	19.5	-.3		
Total	130	100		132	100		205	100			
	Epidemiologists autonomy										
PCU	61	47.7	-.1	63	41.4	-1.2	100	53.5	1.1	6.94	.14
Hospitals	44	34.4	.6	49	32.2	.2	54	28.9	-.6		
Normative	23	18.0	-.6	40	26.3	1.6	33	17.6	-.9		
Total	128	100		152	100		187	100			
	Physician role										
PCU	60	48.8	.1	82	44.6	-.7	82	51.3	.6	1.65	.80
Hospitals	39	31.7	.0	61	33.2	.4	47	29.4	-.5		
Normative	24	19.5	-.3	41	22.3	.5	31	19.4	-.3		
Total	123	100		184	100		160	100			
	Medical manpower										
PCU	54	45.8	-.3	66	49.6	.3	104	48.1	.0	3.53	.47
Hospitals	44	37.3	1.1	41	30.8	-.1	62	28.7	-.7		
Normative	20	16.9	-.9	26	19.5	-.3	50	23.1	.8		
Total	118	100		133	100		216	100			
	Organization										
PCU	67	45.6	-.4	69	50.7	.5	88	47.8	.0	5.48	.24
Hospitals	53	36.1	1.0	44	32.4	.2	50	27.2	-1.0		
Normative	27	18.4	-.6	23	16.9	-.9	46	25.0	1.3		
Total	147	100		136	100		184	100			

S.R.: Standard Residual, X2: Chi-square

7. CONCLUSION

We chose this research topic because during our practice as epidemiologists in the IMSS we realized that in many cases the information systems didn't provide enough flexibility and utility to the lower levels of care. On the other hand since the beginning of public health disciplines until now a lot of achievements and knowledge have been accomplished, today we are in the information era and public health is not indifferent. In Mexico the first steps have been done to implement Interactive Health Communications (IHC) in health fields. The Mexican Institute of Social Security cannot ignore their role to improve epidemiological information systems using IHC.

In this research we got a high response rate mainly because at the time of data collection our timing was most appropriate; the Public Health Coordination was performing a national training to introduce a new information system among all the public health personnel. This was very favorable to us because we attended these training sessions and we met with epidemiologists much faster than we expected; delegation public health coordinators were very kind in answering our questionnaire and helping us to distribute it with their epidemiologists and sending them back to Mexico City. This situation saved us a lot of time during the whole process of distribution and recollection of questionnaires. Secondly it was the first time that IMSS epidemiologists answered this kind of survey and that somehow increased their predisposition to participate. Third, all the epidemiologists saw that this project had the support of their authorities and this assured them that this study could have big impact in their future. Finally, they really want to be heard by their authorities and this opportunity was one of the best chances to express their needs and opinions.

The main reason to exclude questionnaires was because some epidemiologists didn't answer at least 80% of the questions and just few of them didn't want to give a kind and honest reply to our request. Less than five epidemiologists complained about the length or content of the questionnaire, other epidemiologists made nice compliments to this study and a lot of them made suggestions to improve the quality and efficiency of public health activities in the IMSS.

7.1. Demographics and infrastructure

We didn't find differences and associations between gender, age and time working in the IMSS and access to information technology; from our point of view these results can be considered positive because this means that IMSS is not favoring computer equipments distribution on the basis of epidemiologists' gender or age, but in contrast this distribution some how has been relatively unfair to lower levels of care because access to information technology has been prioritized for delegations and central levels but it is in lower levels where the epidemiological information is generated.

It is well known that to accept and use new technology is more difficult to older people and to those that have been working for a long time in one place, but in our research we didn't find these kinds of association. One reason is that more than fifty percent of our study population was in their forties and that they are just in the middle of their active work life; that somehow helps them to accept more easily new technologies.

Small differences were found in the access to Internet and e-mail; epidemiologists with less time working in their current position have more access, but on the other hand a big portion of these people were in the upper levels where there are more access to these tools.

One possible explanation of why we didn't find differences and associations between age groups and time working in the IMSS and time performing the current job position is that most of the epidemiologists were in their 40's and many of them have been working and performing the current position in the same period of time (7-9 years). All of them are in the same generation and tend to be homogeneous in their experiences and preferences of the epidemiological information systems and their opinions towards IHC applications.

Job positions showed strong differences to get information technology access (computers, Internet or e-mail) among levels of care. In general epidemiologists from normative levels were better provided than epidemiologists from the lowers levels.

Time and distance from the workplace to the immediate PH supervisor were geographical barriers to epidemiologists to keep in touch with their supervisors, in particular to epidemiologists from general hospitals and delegations. In this case to have a network between each care center could overcome these barriers and save a lot of time and money traveling.

In general, medical care units have enough staff to perform their activities and only few of them need more PH personnel, in particular office assistants in the lower levels of care.

Two thirds of the epidemiologists have computers at work and this percentage increases in the upper levels of care, where 90% of the epidemiologists in the central level have access to computers. This situation is unequal to the lower levels because it is where the data are generated, processed and transmitted to delegations and central levels.

On the other hand, most of the computers available are not updated which means that in some cases there are serious limitations to keep adequate registries, to store information, to perform data analysis, to elaborate reports and to get Internet connection.

Related to communication technology availability, phone lines were the most common in all levels of care and other efficient technologies like e-mail, FTP, and telnet were not widely used and were just limited to upper levels. E-mail service was only available to less than one-quarter of the epidemiologists, the first three levels of care have even lower coverage and only delegations and central levels have a better access to e-mail in their workplaces. The use of the Internet was very limited in all levels of care. Again it looks like there is not a homogeneous distribution of sources through all levels of care.

For those epidemiologists who said that they have Internet access it was evident that there is a lack of computer education because when they were asked what kind of Internet facilities they have most of them didn't know the meaning of terms like www, telnet. This situation is explicable because Internet service has been introduced recently in the IMSS and apparently there has not been a promotion strategy to introduce epidemiologists to this technology and as a consequence to make a more efficient use of these facilities.

Two of the major impediments to successful use of interactive health communication approaches are cost and access. Users around the world are unanimous in finding the price of Internet access to be a major constraint. A shortage of infrastructure, notably of telephone lines, is a further big obstacle to increasing Internet access in developing countries. [8]

7.2. Work environment

From our point of view it was important to explore work environment in order to get a better panorama of how epidemiologists use the systems, the way that they feed the information systems, how they distribute their time, what they think about their job and with whom they establish networks and communication channels. This information allowed us to understand how epidemiologists are using the information systems, what their needs are and how they interact with the system.

Depending of the level of care, epidemiologists have mainly two types of job profiles one related more with public health care and the other with decision making. In both cases the way that they perceive and use the epidemiological information system differs from each other.

It is difficult to know if epidemiologists are making an inefficient use of their work time, but in both cases (care and normative levels) they are spending a lot of time in data processing and attending meetings. These kinds of activities could be done more efficiently with the help of interactive health information technology that could allow epidemiologists to spend more time doing other epidemiological activities in their local environment.

Computer access is a promoter to do more work activities such as data processing and analysis; in contrast, planning and evaluation activities were more associated with Internet and e-mail access, apparently those epidemiologists with access to communication technologies spent more time doing planning and evaluation than those who don’t. This can be attributed to the fact that epidemiologists from normative levels do more these kinds of activities and also that they have more access to this technology.

Epidemiologists from all care levels distributed their work week mainly in four functions: data analysis, coordination, planning and evaluation, and supervision. Research and teaching activities were functions to which they assigned less time. In the first three levels epidemiologists were more focused on data analysis, coordination and supervision. In contrast epidemiologists from delegations and central levels used most of their time doing data analysis and, planning and evaluation.

The IMSS have a description of epidemiologists' function per level of care but it seems that in practice it is not possible to perform all the functions. Data analysis requires much of the epidemiologists' attention, as well as planning and evaluation; in both cases these functions require keeping good registries, information sources and infrastructure in order to perform them adequately. Research and teaching were the functions that epidemiologists dedicated less time to, in some cases just because the job profile doesn't allow enough time, in other cases because there are lack of resources or lack of epidemiologists' interest to do local research activities or to educate students and health personnel in issues related to public health.

The proportion of time that epidemiologists assigned to do research and supervision activities was not influenced by information technology access like computers or Internet. Even though we found positive associations between those people who have technology access and research activities, the time that epidemiologists spent on it was not affected by having or not having access to information technology.

Networks are very important to some professionals that require team jobs, like epidemiologists who often work with interdisciplinary teams. Epidemiologists' position in the IMSS structure is strategic to the medical care services because most of the epidemiologists are physicians who also have a professional background in public health and health administration, but mainly because they are in a key position between the administrative and clinical areas; they are the bridge between these two groups that quite often are antagonistic. Because of this situation epidemiologists develop networks between departments and health personnel either to discuss epidemiological issues or to get resources and information to perform their activities.

For obvious reasons the chairman, administrator and ARIMAC personnel are the ones with whom epidemiologists establish more networks; they are the decision-makers and information providers in their medical care units. In contrast with other epidemiologists and PH coordinators, they don't discuss epidemiological issues as often as they do with the above personnel, probably because they have geographical barriers, difficulties with open communication channels or just lack of interest.

Epidemiologists who have access to information technology in particular e-mail and Internet tend to develop strongest networks and communication channels with colleagues in their workplaces, with other epidemiologists and with their PH supervisors than those epidemiologists who don't. This means that communication technology access helps epidemiologists not to be isolated from the public health arena.

Communication between departments plays an important role in epidemiologists' performance. Mainly epidemiologists from the first and second levels used to meet or phone their colleagues in the workplace more often; especially they met more with ARIMAC personnel, nurses and intermediate head departments. These health personnel are their closer collaborators.

In spite of the fact that other epidemiologists and PH coordinators are also close collaborators and providers, epidemiologists didn't have constant communication with them. In contrast epidemiologists from delegations and central levels keep more communication between themselves. Possible explanations are that in lower levels there is less access to communication technology, epidemiologists don't have time or they are not interested to meet or talk with other colleagues.

Internet and e-mail access promoted meetings between epidemiologists and other epidemiologists and PH coordinators to discuss epidemiological issues. In contrast, phone calls were more frequent to the chairmen and other epidemiologists for those epidemiologists who have computers in the workplace. As with meetings, phone calls to other epidemiologists and PH coordinators were more frequent with those epidemiologists with access to the Internet and e-mail. These preferences let us know that epidemiologists prefer face to face interaction with people from their same workplace if they don't have many communication technology tools available. In contrast, Internet and e-mail access promote more interaction with people outside of the workplace.

In general the accuracy of the current communication channels was poorly graded mostly by the first three levels; in contrast epidemiologists from central level showed a better opinion. As we said before communication technology is more widely used in the upper levels. This explains why epidemiologists from lower levels did not have a good opinion about the accuracy of the current communication channels.

Epidemiologists that have more access to computer technology agreed more with the accuracy of the current communications channels in their workplaces. This means that they are having more use of these channels and they are using them as tools to perform their activities more efficiently.

The overall satisfaction with the current work design was relatively high (65.34%); nevertheless these data tells us that there are some issues where epidemiologists didn't feel really conformable in their work design, these differences are more evident by level of care; only epidemiologists from delegations showed more satisfaction with their job. On the other hand, epidemiologists expressed some concerns related to feedback and independence. These data are consistent and related to the previous data about feedback reports from their supervisors. Here it is possible that the current communication channels are inefficient, the current design doesn't allow true feedback through the whole network or there is not a job culture to provide and get feedback.

Independence probably was poorly evaluated because epidemiologists feel that they don't have enough independence to make decisions and/or resources in their local environment. Partly it is because they don't work with "finished products". They depend on others to get data and information after they process it and send to their superiors; these are the ones who make the decisions and get the credit and epidemiologists are the ones who do all the "dirty work". Another reason it is that the IMSS is a bureaucratic and hierarchical organization and because of that the system doesn't allow enough independence to perform the epidemiologists' job.

7.3. Research and academics activities

Medical knowledge is evolving rapidly. Historically it has taken up to five years for new knowledge to trickle down, even to those in the general profession who are reasonably well connected to the international flow of communication. [8]

Almost all epidemiologists have a graduate education in public health or epidemiology, and try to be updated regularly with medical courses and literature review. Nevertheless they have poor productivity in research and scientific publications but it also looks like few of them are truly interested in research activities. Some possible explanations are that their current job design doesn't allow them to have enough free time to do research; another reason is that they don't have enough resources, information technology and medical literature access. Also it is possible that in spite of their scientific background they are not very interested in research.

This observation is supported by the fact that epidemiologists from delegations are the ones who do more research activities and they are the ones who have more information technology access even though their job profile is more oriented to decision-making. The others who do more research are epidemiologists from NMC. In these centers usually there are research centers led by clinicians with graduate studies in sciences; it is possible that in these places epidemiologists are more exposed to research environments and also have more access to technology and medical literature.

In contrast, epidemiologists from PCU have been published more papers than epidemiologists from other levels but proportionally they are the ones who are doing less research activities.

This research showed that those epidemiologists who have more information technology access tend to have more research activities as well as to publish more than those who don't. So, if epidemiologists would have a work environment more oriented to information technology applications they would do more research activities and in consequence it would be more beneficial to their communities.

Epidemiological topics preferences are quite narrow and limited to infectious diseases and some chronic diseases like diabetes mellitus and some types of cancer. Nevertheless these topics have a real public health importance to Mexico health status, the reality is that epidemiologists have little interest in topics like molecular epidemiology, genetics, injuries, mental diseases and health informatics that currently are the most advanced research topics to approach infectious and chronic diseases and patient care management.

Epidemiologists' participation in the local research committees is very low, in some cases just because there are not research committees in their medical units but in others cases it could be because clinicians don't see epidemiologists as good advisers in research issues.

Although epidemiologists read a wide variety of medical literature, apparently the language barrier to reading scientific papers in other languages different from Spanish is quite significant. Their journal' options are very limited to Mexican articles; this situation tells us that besides the language barrier, perhaps there is limited access to medical journals, well provided libraries or Internet access in their workplaces; also it can be that the subscription costs to international journals are too high to afford.

Even though there are limitations to getting international journals, epidemiologists are using more than one source to keep updated, like libraries, books, scientific meetings and the Internet; the last one somehow is becoming an important information source to them.

Teaching activities are not very important because less than 50% of epidemiologists have students. Most of the epidemiologists who perform this activity are in the lower levels. It would be interesting to explore in future studies the quality of these activities as well as the resources available and the academics content that epidemiologists use to teach their students.

7.4. Epidemiological information systems

Epidemiologists are very intensive users and feeders of the epidemiological information systems in the IMSS. They spent most of their time doing epidemiological surveillance, feeding the information systems, supervising and coordinating preventive medicine and health promotion activities. Practically all these epidemiological activities are linked to the information systems. This fact makes that epidemiologists keep detailed and organized records to update constantly the information systems.

Epidemiologists use several information sources to feed the systems, to support it they establish networks and communication channels with medical personnel either in their workplace or outside. In some cases they design their own registries or adapt official reports forms to organize the data. Information technology access to support these activities is still limited to all epidemiologists.

Barriers to integrating preventive services into clinical health care are well documented and include lack of standardized counseling protocols. The need for providers to address multiple health behaviors also serves as a barrier to preventive services. These barriers limit the provision of recommended behavior-change services of physicians, nurses, and other providers who are not trained or reimbursed for these important tasks. [(33)]

The amount of reports completed and sent by epidemiologists was high and the frequencies of these reports were heterogeneous through all levels of care. This implies that some of the epidemiologists invest much time reporting to their immediate PH supervisors.

Feedback was heterogeneous among levels of care. Almost 80% epidemiologists got feedback from their immediate PH supervisor, but epidemiologists from central level received the lowest feedback; this can be explained because they are in the highest job position and they don't need feedback or also it could be that really they don't get feedback from their bosses. Apparently epidemiologists from delegations were the most involved in providing feedback.

As we expected SUI-29 and SIVEIMSS were the systems that got more feedback. These systems provide information related with preventive medicine productivity and data of new cases of diseases of public health importance. Nevertheless feedback received from these reports seems to be not good enough in all levels of care and, only delegation levels had a favorable situation in this issue.

Epidemiologists graded the accuracy of each information system relatively low, in particular the Mortality reports and Supplies and Budget reports were less popular. This indicates that there is something wrong with these systems, that they are not offering enough utility to satisfy epidemiologists' needs or that some epidemiologists really didn't know these systems or didn't know how to use them.

On the other hand, if the overall accuracy given to the epidemiological information systems was just good, then it would be necessary to assess more detailed this systems in future research in order to know what parts of these systems are not working properly and why they are not satisfying epidemiologists' needs.

Reports activities tend to be more intensive to those epidemiologists with information technology access and feedback was not strongly associated, as well as epidemiologists' opinions about the accuracy of the epidemiological information systems. It is evident that the performance of these activities is not strongly dependent on computer applications. That's why our associations were not significant.

To determine whether findings can be generalized for use in different organizations and situations, one should consider the characteristics of the patient population (demographics) and the characteristics of providers (culture, incentives, willingness to chance or adapt). [11]

At least half of the epidemiologists provided comments or suggestions to modify or improve reports that we chose as indicators. Besides these comments, epidemiologists expressed concerns about organizational problems in their work places that affect the data quality to feed these systems. These observations assure us that it is necessary to assess or review more deeply these information systems

In the open questions section we explored epidemiologists' comments about the most frequent predicaments in getting data, elaborating and sending reports; we found that in almost all levels of care the lack of resources, organizational problems and deficient communication channels were the consistent problems in all of them. These problems were more acute in the first two levels and the central level had fewer problems. This fact is an indication that modifications have to be done to improve these processes to make them more efficient.

Around fifty percent of epidemiologists just agreed with the performance of the current surveillance system and they consider good tools the notification forms available. In contrast almost sixty percent thought that the current notification channels are not slow. But the accuracy of some specific notification forms was just agreed by epidemiologists with something between 43% (uterine cancer notification form) to 53% (Cholera notification form). This is a clear indication that epidemiologists in charge of designing and reviewing epidemiological notification forms must take into account epidemiologists' comments from the lowest levels of care. But also these findings have to be studied more deeply in order to provide more detailed information about what is needed and how to provide better support to epidemiologists in lower levels.

By increasing the personalized health care information available to patients in real time, the availability of online information systems may increase the knowledge of some consumers to such an extent that they will become quite discerning and sophisticated purchasers of health services [(6, 7)]. A good example of how IHC applications can be useful to public health is the online applications of the WHO global network of influenza centers. [(28)]

Health promotion activities seem to be widely spread among epidemiologists, mainly to those from primary care units and general hospitals. Even though they have a good variety of resources to perform these activities they don't use technological resources like PowerPoint presentations on computer projectors.

A number of key pathways of information technology evolution are creating new opportunities for delivering professional education in preventive medicine and other health domains, as well as for delivering automated, self-institutional health behavior-change programs through the Internet. [(27, 34)]

Immunizations received much attention from epidemiologists, especially to those in the first and second levels of care. They had different kinds of controls to monitor coverage, productivity and supplies; some of these controls are IMSS forms; others had been developed by epidemiologists themselves. Evidently these combinations of type and amount of controls let us know that there is heterogeneity on how epidemiologists register and handle their records. This implies that in some cases the reports that they elaborate not necessary are standardized. As a consequence, these reports are not highly reliable and accurate. On the other hand the facts that epidemiologists have the initiative to keep controls of their activities tell us that they are interested in doing their job well even if they don't have the best conditions.

In addition to epidemiologists using very frequently the PROVAC registry, as a source for supporting immunization coverage, they have a good opinion about the accuracy of PROVAC. But at the same time the effort to keep this registry updated is time consuming, tedious and requires a lot of effort to get and enter the data, in particular when some medical care units don't have computers to enter data. To perform activities of these kinds automated information systems are the best option to keep the system updated as well as to allow people to monitor and follow it up.

Epidemiologists who have computer technology access agreed more with the accuracy of PROVAC than those who don't. It's quite reasonable to expect this response because PROVAC is a complex system that requires a lot of time and effort to keep it updated. On the other hand having internal controls to monitor immunizations were not associated with computer access technology, because these registries have to be keep and updated in order to feed properly the information systems independent of having or not having technological support.

Screenings also received great attention from the epidemiologists, as we expected screenings on diabetes mellitus, hypertension and uterine cancer were the most popular, and this is congruent with the current prevalence of these diseases in Mexico. Though it is not the purpose of this research, it would interesting to investigate if these amounts of screening are having a real impact on the population to make early diagnoses, to prevent complications and to encourage people to adopt healthier life styles.

According with the profile of each level of care it looks like there is a little confusion about what are the most appropriate screenings to do on each level, because there are many public health services in hospitals and national medical centers that are doing screenings with a population that apparently has the chance to do their screenings in their own primary care unit.

As immunizations, epidemiologists also have several internal controls to monitor screening activities and some of them use more than one control. Here there are problems to having standardized and homogeneous reports from these registries.

Internal controls to monitor screenings were not associated with computer access technology, because like immunizations activities these registries have to be kept and updated independent of having or not having technological support.

Almost eighty five percent of epidemiologists have under treatment and control patients with tuberculosis and almost three quarters of them have patients with sexually transmitted diseases, but other diseases like malaria and rheumatic fever are less frequent. In the past there were solid reasons to make epidemiologists to keep under treatment and control some patients with diseases of big public health importance like tuberculosis, rheumatic fever and malaria. Nowadays the distribution, pattern and characteristics of these diseases have changed and requires new approaches to handle it, so it would be very convenient if some of these programs are submitted to review and updating in order to know if it is still needed for epidemiologists to take care of these patients or if this responsibility should be transferred or shared to other physicians.

In order to improve the performance of each epidemiological information system, epidemiologists' needs were focused on issues related with the simplification, flexibility and standardization of some processes of these information systems and increase the information access in the lower levels. They suggested modifications to some notifications and reports forms, improvement of communication channels with Internet applications, providing more resources and developing of online notification systems.

The epidemiological information systems are working well but they are not necessarily efficient for supporting health decision-making among all levels of care. Epidemiologists require from the health information system more access, flexibility and interaction in order to improve the performance of their services and to take care of other epidemiological activities that have more impact on the health population.

We believe that to improve the quality and satisfaction of the epidemiologists' job it is necessary to work with them and decision-makers to analyze and resolve the weaknesses of the epidemiological information systems. Also it is necessary to establish bigger networks among epidemiologists to share experiences and to support each one.

New information technologies may provide a way to ensure and improve quality in health care while at the same time preserving and even enhancing the autonomy of health care providers [6, 7]. IHC applications, through their information, emotional support, decision support and behavior change services, have the potential to dramatically improve the public's quality of life and reduce the total burden of illness and injury. [1]

7.5. Interactive health communications applications

Some of the major problems that emerge with the introduction or operation of medical information systems are: the attitude of medical personnel concerning the systematization of medical information, the attitude of medical personnel towards necessary information, and technophobia, namely prejudice against computers and advanced medical instruments. [37]

Computer applications in public health such as patient care, medical decision-making and physician substitute in general were considered by epidemiologists as convenient or very convenient, even though we found a little resistance in some particular issues related with physician substitute tools, such as to allow patient and paramedical personnel to have a more active role in their health care. Somehow this attitude is expected because physicians tend to be very conservatives about sharing the power and responsibilities with others unless they are physicians as well.

Several areas of health information policy are already undergoing extensive review in the context of expanded use of telecommunications and computer technologies. These include health data and information standards, network security issues, and legislative actions at the federal and state levels addressing issues such as medical information privacy, confidentiality, and security. [32]

In this research, issues related with the consequences of the use of computer in medical fields found almost unanimous acceptance from epidemiologists. They thought that automated information systems will decrease the cost of medical care in their health centers, also they didn't feel afraid to lose control over some processes related to data entering, monitoring, privacy, or to have legal and ethical problems if they start using information technology, if this implies that they will have more autonomy to perform their job, even though they expressed some concerns about privacy.

Also they didn't think that their role with patients would deteriorate or be threatened if they start using information technology; they are optimistic about learning how to use computer systems, they don't see computers systems as time consuming and they don't expect that patient satisfaction will be affected negatively. On the other hand they didn't feel afraid to lose their job with the arrival of computer applications. Epidemiologists opined that computer applications would improve the organization and would favor decentralization.

IHC applications are available on a wide variety of health topics and can focus on a single health condition or target a group of conditions. These programs range from applications designed to convey limited health information to complex clinical decision-support tools and modules that are designed to influence health behaviors. [(1)]

Epidemiologists considered it very convenient to have some computer tools such as text processors, statistical software, and relational databases, but they were more optimistic about using interactive online applications such as the Internet, online consultations, communication in real time and online reporting and feedback systems. In spite of the limited access to the Internet epidemiologists already have some general idea of what computer can do for them to do more efficient their jobs.

Even though epidemiologists in general showed a very positive attitude towards computer applications and the consequences of their use in public health field, we did not find that their opinions were influenced by computer technology access. This can be explained in part because there were not many epidemiologists who have computer technology access this could contribute to the differences on epidemiologists' opinions.

Gender and age were variables that did not influence epidemiologists' opinions about the convenience of computer applications; but oldest epidemiologists showed more disagreement to epidemiologists' autonomy applications. Job position time didn't show a difference among groups, but epidemiologists with more time working in the same position expressed more concerns to medical manpower applications. Epidemiologists who have been working more than fifteen years in the IMSS expressed similar concerns. There are strong evidences in the medical literature that people who have been working for a long period of time in the same place or position tend to show more resistance to adopting new work design and technologies.

Job position didn't show significant differences among epidemiologists in their opinions about computer applications, but epidemiologists from normative levels showed more concern for epidemiologists' autonomy applications. Even though epidemiologists from upper levels have been exposed to more information technology than others, their opinions about interactive health communication applications were not influenced by this exposure.

One possible explanation of why epidemiologists' opinions towards IHC were very positive is because independent of whether or not they have information technology access at work; they have permanently the opportunity to take courses within the IMSS to acquire computer skills. This situation promote epidemiologists be involved with IHC.

In general epidemiologists among all levels of care had a positive attitude toward computer applications in the public health field. They seem to be ready to be involved in computer network environments, so if their authorities decide to implement computer networks epidemiologists could be good allies to test and to promote their use with other medical personnel.

Applying IHC technologies can eliminate or greatly reduce most of the barriers to the delivery of preventive services. A computer program can screen multiple behaviors, prioritize areas of intervention, and initiate the intervention in a reasonable time frame. [33]

In general epidemiologists with access to computer technology had better expectations about the success and accuracy of automated information systems in public health as well as about the chance that they and their co-workers will use it. We expected this response because people that have been exposed to technology tend to appreciate more the boundaries of computer technology.

With no surprise epidemiologists still though that even with the arrival of computers systems the most suitable people to enter data in automated information systems would be the PH nurse, ARIMAC personnel and themselves as it occurring now without computers. So they believed that these duties don't have to be shared with other kind of personnel. Besides they see in ARIMAC personnel an important ally to support them in computerized work environments.

The Dutch experience with nationwide IHC is a very illustrative example of how useful it can be to medical fields and how the agreements between users and decision-makers can conduct to develop successful applications. [30]

Epidemiologists are firmly willing to have computer networks in their workplaces and they trust that this kind of technology will be accurate and successful in their services, but on the order hand they are a little bit concerned about the reaction of their colleagues to the use of this kind of network.

7.6. Limitations and strengths of this research

Limitations of this study were the design and the amount of the variables studied. It didn't allow us to study more deeply some information systems, like surveillance and epidemiological information system. These two systems per se are big and complex and require individual approaches in order to get a better understanding of their performance, structure, processes and nature of the data needed to feed the system.

IMSS epidemiological information systems are big and complex but in order to get a first overview of epidemiologists' needs concerning these systems, for us a survey was the best approach to establish a baseline study.

For example one approach is to study one information system per time where an integral research can be done assessing the whole process through critic routes, times and movements, resources available and cost-effectiveness of the interventions. In this way we can get a better overview of what is wrong, what has to be modified and what resources need to be improved.

It is possible that because of the study design we didn't were able to identify some cause-effect relationships with some variables, even though the findings allowed us to do some inferences that could be tested in future studies.

The importance and transcendence of this work is not only for epidemiologists but also for the IMSS and Public Health Services in Mexico, This study is one of the first to be done with a big group of epidemiologists in Mexico. Secondly these results could be used as a reference or baseline to future studies to explore more deeply some of these results or also as a follow-up when more information technology will be available in the IMSS. It would be interesting to see how some variables have been changing through time. Thirdly this research can be applied as a technology assessment model in epidemiological information systems and IHC applications in other countries with similar health care systems as Mexico.

Also this research could be used as a reference to develop cost-benefit and cost-effectiveness studies to assess pros and cons of investing on information technology and the impact in the public health system and health population. This study provides some highlights for decision-makers, for example, currently epidemiologists are willing to work in automated networks environments therefore; they could be a good target population for these kind of studies. For example decision-makers can select one information system to automate and test it with epidemiologists the performance, efficiency and quality of this system.

From the health care provider or purchaser perspective, it is important that evaluations of IHC applications address outcome related to quality of care and cost effectiveness. One outcome to consider may be the potential for market growth with the use of IHC applications. Cost saving may be expected from systems that facilitate disease management, self-care, and self-triage. [11]

The IMSS has been not indifferent to incorporating communication and information technology. At the beginning of the sixties a research team introduced the first computer system to support medical activities. In the late 70's IMSS-Coplamar program began and radio-communications systems were incorporated to support rural medical centers. During 1995-2000 the systems of

Family Medicine XXI Century, hospital management, laboratories system and diagnosis related groups and medical areas of decentralized management were developed. [41]

Since 2001 several modifications to the law were approved to allow the use of digital signatures, certifications, electronic transactions and medical electronic records. In parallel IMSS emigrated some of its biggest administrative systems to automated networks such as affiliation and billings. In the same year the first digital imaging system was opened and it began to enforce PCU with computers and communication equipment to 101 units. With the support of the National Autonomous University of Mexico the IMSS developed the first videoconference room. By 2006 IMSS is expecting to have completely connected all MCU from the three levels of care to become part of the IMSS network. [41]

As we see IMSS has been investing in information technology in spite of their financial problems and workers' resistance to adopt such technologies. Slowly medical areas are opening spaces to experience the boundaries of IHC, like the introduction of Internet, FTP and e-mail to send medical reports and information. Other examples can be seen on the website of the Directorate of Medical Care Benefits [42]: online IMSS medical journals [43], medical education [44], health research [45], health statistics [46], health information to general population through PREVEIMSS [47] and information about natural disasters [48], guidelines of medical practice to family medicine [49] and medical technology assessment [50].

Even though IMSS has been making good efforts to introduce IHC it isn't enough; the institution has to work more closely with medical areas to sensitize and involve them in the process. Otherwise the gap between administrative and medical areas will increase. Two approaches to reduce the resistance of medical personnel in adopting IHC is to provide more information about what are IHC and how they can support their job; the second is to provide training sessions and continuous education.

One suggestion to the IMSS authorities is to keep in mind experiences of other countries such as The Netherlands, Great Britain and United States, where the access to health information in interactive forms is widely open, as well as the development of IHC.

Ideally, evaluation should be designed at the conception of a system. Consumer needs and the desired effect of a system should be clearly specified prior to system implementation. The desired effects should help define the outcomes of interest and evaluation design to carefully measure those outcomes. [(11)]

Inaccurate or inappropriate health information and poorly designed applications may result in harmful outcomes, such as receiving inappropriate treatment or delaying necessary health care-seeking behavior [(1)]. Then if the new tools doesn't contribute to improve the work, independently of what innovative would be the new tool the probabilities of failure would be greatest if in the practice doesn't resolve at least the users' minimum needs. [(33)]

President Fox's administration understood that it is important to invest in interactive communication technology; his government has been looking for innovative strategies to reduce the gap between rich and poor in order to provide more health, education and economy. One of these strategies is the National System e-Mexico.

The e-Mexico project started almost three years ago. In June 05, 2003 it was open to the public with 3,200 hosts in the whole country. Their goal is to reach 12,600 hosts by 2006 [(51-53)]. Many governmental institutions and private companies and institutions have been working together to implement the infrastructure and to develop the concept and contents.

The main goals of e-Mexico National Program are to eliminate barriers in getting information and public services, and to reduce the gap within the country and between the Mexican population and the rest of the world. [54, 55]

E-Mexico portal is the media to articulate government interests, telecommunications and information networks with the purpose of increasing coverage of basic services such as education, health, economy, government, science, technology and industry. [53-55]

Most of the people in Mexico don't have phone lines, computer access and fewer Internets. Nevertheless e-Mexico wants to provide phone and information technologies to approximately 2,500 municipalities and 14,000 villages in the country during the next five years. [53, 55]

One component of e-Mexico is e-health (e-Salud) program. Its goals are to contribute to improving health population and increasing health care coverage given priority to inhabitants of the most marginal villages through telemedicine applications. The second goal is to provide health information to the population and to support training and continuous education to health personnel [56]. In this project are participating the Ministry of Health, IMSS, ISSSTE and some private organizations.

They want to consolidate two projects: telemedicine and e-health portal. The first one's focus is to support health workers from all levels of care with diagnosis, treatment and management applications as well as with continuous health education. The e-health portal wants to keep informed general population about health promotion activities and prevention, but also to do administrative procedures. [56]

In this context our research contributes to the e-health program with information to develop applications to medical personnel in matters such as interactive health information systems, online surveillance and notification systems and research networks. Also our project opens the door to investigate new approaches of computer applications in medicine and technology assessment in IHC.

7.7. Recommendations

Follow-up studies every two or three years of this research with the same population during some period of time are convenient, in order to assess if there are changes on epidemiologists' needs and opinions towards epidemiological information systems and work environment and the introduction of more IHC. But also in future researches it could be more efficient to add more specific questions in some variables related with epidemiological information systems, work environment and IHC applications.

In order to improve the current epidemiological information systems, we would like to recommender decision-makers to use these study findings and work with epidemiologists; as well as to keep in mind the current epidemiologists' work environment and epidemiologists' opinions towards ICH before implement any information system or new automated networks.

We strongly encourage other researchers and decision-makers to use this study as a baseline or reference to perform future research on epidemiological information systems, interactive health communication applications, work environment and research and academic activities. For example, it could be useful to perform cost/benefit analysis to assess the impact of IHC in public health; develop surveys with each information system in order to assess it with more detail; also these findings can be used to support the development of nationwide IHC applications.

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